

# ***Michael Renzulli - LSRP***

71 Potts Road, Robbinsville, NJ 08691

Office/Fax: 609-249-2699

Mobile: 609-744-7445

E-mail: [mike@renzullilsrp.com](mailto:mike@renzullilsrp.com)

February 15, 2021

Mr. Charles Zielinski  
Bureau of Case Management  
P.O. Box 420. Mail Code 401-05F  
401 East State Street  
Trenton, NJ 08625

**RE: Bayway Refinery Complex Site Remediation  
Investigative Area of Concern A18 (Pitch)**  
▪ Revised Feasibility Study Report Addendum  
▪ Technical Impracticability Report  
▪ Pilot Program Completion Report  
**Bayway Refinery  
1400 Park Avenue  
Linden, Union County, New Jersey  
SRP PI# 008282**

Dear Mr. Zielinski:

Enclosed please find one electronic copy of each of the following reports for Investigative Area of Concern (IAOC) A18 (Pitch) for the Bayway Refinery Complex (BRC) in Linden, New Jersey prepared on behalf of ExxonMobil Environmental and Property Solutions Company by Kleinfelder, Inc.:

- Revised Feasibility Study Report Addendum
- Technical Impracticability Report
- Pilot Program Completion Report

As LSRP for the BRC, I have reviewed the attached three documents and I find the presentation of the data to be acceptable and compliant with requirements contained with N.J.A.C 7:26E. I find the studies and recommendations to be protective of human health and safety and the environment and to be consistent with the approved version of the Remediation Strategy Road Map document for the site. I therefore approve the submittal of the IAOC A18 Revised Feasibility Study Report Addendum, the Technical Impracticability Report, and the Pilot Program Completion Report to the New Jersey Department of Environmental Protection.

Please contact me at (609) 249-2699 should you have any questions.

Best regards,

**Michael Renzulli - LSRP**



Michael J. Renzulli, P.G., LSRP

Enclosure

Cc: M. Forlenza – ExxonMobil Environmental and Property Solutions Company  
P. Lucuski - Kleinfelder



**ExxonMobil Environmental  
and Property Solutions**

Park & Brunswick Avenue  
Building 7 – Site Remediation  
Linden, New Jersey 07036  
703.963.7132 Telephone

**Maureen P. Forlenza**

Bayway Team Lead Project Manager



Date: 2/15/2021

Mr. Mike Renzulli, PG, LSRP  
Michael Renzulli - LSRP  
71 Potts Road  
Robbinsville, New Jersey 08691

**Re: Bayway Refinery Complex Site Remediation:  
Revised Feasibility Study Report Addendum  
Technical Impracticability Report  
Pilot Program Completion Report  
Investigative Area of Concern A18 (Pitch)  
Bayway Refinery  
1400 Park Avenue  
Linden, Union County, New Jersey  
SRP PI# 008282**

Dear Mr. Renzulli:

Enclosed please find one electronic copy of each of the following reports for Investigative Area of Concern (IAOC) A18 (Pitch) prepared on behalf of ExxonMobil Environmental and Property Solutions Company by Kleinfelder, Inc.:

- Revised Feasibility Study Report Addendum
- Technical Impracticability Report
- Pilot Program Completion Report

Please sign the attached New Jersey Department of Environmental Protection (NJDEP) Traditional Oversight Form for submittal to the NJDEP Case Manager, Charles Zielinski.

The reports will be initially submitted to the NJDEP electronically, followed by the original hard copies (with an additional electronic version) within the next 30 days.

Please contact me at (703) 963-7132 if you have any questions.

Sincerely,

A handwritten signature in blue ink, reading 'Maureen Forlenza', is written over a light blue horizontal line.

Maureen Forlenza  
Bayway Team Lead Project Manager

cc: S. Ferreira – USEPA (electronically)  
D. LaMond – Phillips 66 (electronically)  
C. McCardell – Stantec (electronically)





New Jersey Department of Environmental Protection  
Site Remediation and Waste Management Program

TRADITIONAL/DIRECT OVERSIGHT  
REPORT CERTIFICATION FORM

Date Stamp  
(For Department use only)

SECTION A. SITE NAME AND LOCATION

Site Name: ExxonMobil Bayway Refinery Complex

List All AKAs: \_\_\_\_\_

Street Address: 1400 Park Avenue, Building 7

Municipality: Linden (Township Borough or City)

County: Union Zip Code: 07036

Program Interest (PI) Number(s): 008282 Case Tracking Number(s): RCP000002

SECTION B. REPORT INFORMATION

Report Name: Technical Impracticability Report; Revised Feasibility Study Report Addendum; Pilot Program Completion Report

Report Date: 12/09/2020

Case Type:

☒ RCRA GPRA 2020 ☐ CERCLA/NPL ☐ USDOD ☐ USDOE ☐ Direct Oversight

☐ Other (explain): \_\_\_\_\_

SECTION C. PERSON RESPONSIBLE FOR CONDUCTING THE REMEDIATION INFORMATION AND CERTIFICATION

Full Legal Name of the Person Responsible for Conducting the Remediation: EM Environmental & Property Solutions Co

Representative First Name: Maureen Representative Last Name: Forlenza

Title: Bayway Team Lead Project Manager

Phone Number: (703) 963-7132 Ext: \_\_\_\_\_ Fax: \_\_\_\_\_

Mailing Address: Park and Brunswick Avenue - Building 7 - Site Remediation

City/Town: Linden State: New Jersey Zip Code: 07036

Email Address: maureen.p.forlenza@exxonmobil.com

This certification shall be signed by the person responsible for conducting the remediation who is submitting this notification in accordance with Administrative Requirements for the Remediation of Contaminated Sites rule at N.J.A.C. 7:26C-1.5(a).

*I certify under penalty of law that I have personally examined and am familiar with the information submitted herein, including all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, to the best of my knowledge, I believe that the submitted information is true, accurate and complete. I am aware that there are significant civil penalties for knowingly submitting false, inaccurate or incomplete information and that I am committing a crime of the fourth degree if I make a written false statement which I do not believe to be true. I am also aware that if I knowingly direct or authorize the violation of any statute, I am personally liable for the penalties.*

Signature: 

Date: 2/16/21

Name/Title: Maureen Forlenza/PM EMEPSC, Agent/Attorney in fact EMC

## SECTION D. LICENSED SITE REMEDIATION PROFESSIONAL INFORMATION AND STATEMENT

LSRP ID Number: \_\_\_\_\_

First Name: \_\_\_\_\_ Last Name: \_\_\_\_\_

Phone Numbers: \_\_\_\_\_ Ext.: \_\_\_\_\_ Fax: \_\_\_\_\_

Mailing Address: \_\_\_\_\_

Municipality: \_\_\_\_\_ State: \_\_\_\_\_ Zip Code: \_\_\_\_\_

Email Address: \_\_\_\_\_

This statement shall be signed by the LSRP who is submitting this notification in accordance with N.J.S.A. 58:10C-14, and N.J.S.A. 58:10B-1.3b(1) and (2).

(1) *I certify, as a Licensed Site Remediation Professional authorized pursuant to N.J.S.A. 58:10C-1 et seq. to conduct business in New Jersey, that for the remediation described in this submission, and all attachments included in this submission, I personally: Managed, supervised, or performed the remediation conducted at this site that is described in this submission, and all attachments included in this submission; and/or periodically reviewed and evaluated the work performed by other persons that forms the basis for the information in this submission; and/or completed the work of another site remediation professional, licensed or not, after having: (1) reviewed all available documentation on which I relied; (2) conducted a site visit and observed the then-current conditions and verified the status of as much of the work as was reasonably observable; and (3) concluded, in the exercise of my independent professional judgment, that there was sufficient information upon which to complete any additional phase of remediation and prepare workplans and reports related thereto.*

(2) *I certify:*

- *That I have read this submission and all attachments to this submission;*
- *That in performing the professional services as the licensed site remediation professional for the entire site or each area of concern, I adhered to the professional conduct standards and requirements governing licensed site remediation professionals provided in N.J.S.A. 58:10C-16;*
- *That the remediation conducted at the entire site or each area of concern, that is described in this submission and all attachments to this submission, was conducted pursuant to and in compliance with the remediation requirements in N.J.S.A. 58:10C-14.c;*
- *That the remediation described in this submission, and all attachments to this submission, was conducted pursuant to and in compliance with the regulations of the Site Remediation Professional Licensing Board at N.J.A.C. 7:26l; and*
- *That the information contained in this submission and all attachments to this submission is true, accurate, and complete.*

(3) *I certify, when this submission includes a response action outcome, that the entire site or each area of concern has been remediated in compliance with all applicable statutes, rules, and regulations and is protective of public health and safety and the environment.*

(4) *I certify that no other person is authorized or able to use any password, encryption method, or electronic signature that the Board or the Department have provided to me.*

(5) *I certify that I understand and acknowledge that:*

- *If I knowingly make a false statement, representation, or certification in any document or information I submit to the Department I may be subject to civil and administrative enforcement pursuant to N.J.S.A. 58:10C-17.a.1(a)through (f) by the Board, including but not limited to license suspension, revocation, or denial of renewal; and*
- *If I purposely, knowingly, or recklessly make a false statement, representation, or certification in any application, form, record, document or other information submitted to the Department or required to be maintained pursuant to the Site Remediation Reform Act, I shall be guilty, upon conviction, of a crime of the third degree and shall, notwithstanding the provisions of subsection b. of N.J.S.2C:43-3, be subject to a fine of not less than \$5,000 nor more than \$75,000 per day of violation, or by imprisonment, or both.*

(6) *I certify that I have read this certification prior to signing, certifying, and making this submission.*

LSRP Signature: Michael Ranzulli

Date: 2/15/2021

LSRP Name: \_\_\_\_\_

Company Name: \_\_\_\_\_

Completed forms should be sent to:

*Assigned Case Manager*  
Bureau of Case Management  
Site Remediation Program  
NJ Department of Environmental Protection  
401-05F  
PO Box 420  
Trenton, NJ 08625-0420

Certifications

Submissions: **Revised Feasibility Study Report Addendum**  
**Technical Impracticability Report**  
**Pilot Program Completion Report**  
**Investigative Area of Concern A18 (Pitch)**  
Bayway Refinery Complex  
Linden, New Jersey

Date:

General Objection

ExxonMobil objects to the certification requirement and reserves all rights to the extent that the requirement of a certification and its terms herein are inconsistent with contractual provisions and conduct under the Administrative Consent Order (ACO) executed between ExxonMobil and the Department. Further, due to the limitations imposed by the necessary manner in which data and other information is collected and summarized, there is no one person who has direct knowledge of all the information used to prepare this submission and who also has overall responsibility for all of the information contained in the submission.

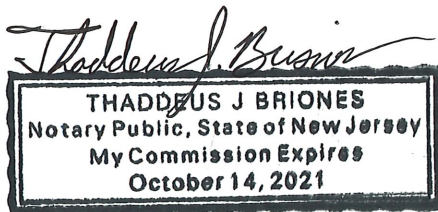
N.J.A.C. 7:26E-1.5(a)

This submission is certified pursuant to N.J.A.C. 7:26B-1.6 and the certification is made subject to the statutory provisions of N.J.S.A. 2C:28-3(a). Because of the limitations imposed by the manner in which information is collected and summarized, there is no one person who has direct knowledge of all the information used to prepare the submission and who also has overall responsibility for all of the information contained in the submission; however, based on the above and the General Objection and my review of the information transmitted in this submission:

"I certify under penalty of law that I have personally examined and am familiar with the information submitted herein including all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, to the best of my knowledge, I believe that the submitted information is true, accurate and complete. I am aware that there are significant civil penalties for knowingly submitting false, inaccurate or incomplete information and that I am committing a crime of the fourth degree if I make a written false statement which I do not believe to be true. I am also aware that if I knowingly direct or authorize that violation of any statute, I am personally liable for the penalties."

Notarized:

Date:



2/16/2021

A handwritten signature in blue ink, which appears to read "Maureen Forlenza", is written over a horizontal line.

Maureen Forlenza  
Bayway Team Lead Project Manager,  
ExxonMobil Environmental and Property  
Solutions Company – Agent and  
Attorney in Fact for ExxonMobil



**TECHNICAL IMPRACTICABILITY REPORT  
INVESTIGATIVE AREA OF CONCERN (IAOC) A18  
PITCH AREA  
BAYWAY REFINERY COMPLEX — LINDEN, NEW JERSEY**

**December 9, 2020**

Copyright 2020 Kleinfelder  
All Rights Reserved

**ONLY THE CLIENT OR ITS DESIGNATED REPRESENTATIVES MAY USE THIS DOCUMENT  
AND ONLY FOR THE SPECIFIC PROJECT FOR WHICH THIS REPORT WAS PREPARED**



A report prepared for:

ExxonMobil Environmental & Property Solutions Company  
1900 East Linden Avenue, Building 28A  
Linden, New Jersey 07036

**Technical Impracticability Report**  
**Investigative Area of Concern (IAOC) A18**  
**Pitch Area**  
**Bayway Refinery Complex— Linden, New Jersey**

Kleinfelder Job No. 20203020.001A

Prepared by:

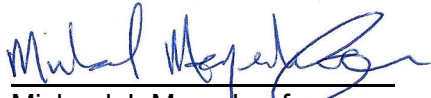


David Hutnick  
Project Professional

12/9/2020

Date

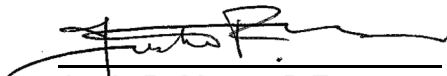
Reviewed by:



Michael J. Meyerhoefer  
Senior Project Manager

12/9/2020

Date



Justin R. Moses, P.E.  
Senior Principal Professional

12/9/2020

Date



Paul C. Lucuski, P.E.  
Program Manager  
License Number 24GE04753600

12/9/2020

Date



# TABLE OF CONTENTS

<b>EXECUTIVE SUMMARY</b>	<b>1</b>
<b>1 INTRODUCTION</b>	<b>9</b>
1.1 Purpose and Scope	9
1.2 Site Setting	9
1.2.1 Former Pitch Disposal Area	9
1.2.2 Mudflat Area	10
1.2.3 Area East of the Poly Ditch	10
1.2.4 Refinery Infrastructure	11
1.2.5 Morses Creek	13
1.2.6 Poly Ditch	13
1.3 Regulatory Background	13
1.3.1 BRC-Wide Background	13
1.3.2 IAOC A18 Regulatory and Environmental Background	16
1.3.3 EPH Guidance Applicable to IAOC A18	18
1.4 Receptors	19
1.5 Report Organization	19
<b>2 REVISED FEASIBILITY STUDY REPORT OVERVIEW</b>	<b>20</b>
2.1 Conceptual Site Model	20
2.1.1 Nature and Extent of Pitch Material	20
2.1.2 Surficial and Subsurface Lithology	21
2.1.3 Soil Exceedances	22
2.1.4 LNAPL Conceptual Site Model	22
2.1.5 Ground Water to Surface Water Migration Pathway	24
2.1.6 Surface Water Inundation	24
2.2 Remedial Alternatives Evaluation	25
2.2.1 Screening of General Remedial Strategies and Technologies	25
2.2.2 Evaluation of Remedial Technology and Process Options	26
2.2.3 Detailed Evaluation of Comprehensive Remedial Action Alternatives	27
2.3 Proposed Remedial Alternative for IAOC A18	32
<b>3 TECHNICAL IMPRACTICABILITY EVALUATION</b>	<b>34</b>
3.1 Applicability of NJDEP Regulations and Guidance	34
3.1.1 NJDEP's April 30, 2019 RFSR Comment Letter	34
3.1.2 NJDEP's Evaluation of Extractable Petroleum Hydrocarbons in Soil Technical Guidance	35
3.1.3 <i>USEPA Office of Solid Waste and Emergency Response Directive 9234.2-25</i>	37
3.2 Technical Impracticability Considerations	38
3.2.1 Third-Party Ownership and Active Refinery Infrastructure	40

3.2.2	Physical Characteristics of Surface and Subsurface Materials .....	46
3.2.3	Surface Water .....	51
3.2.4	Air Emissions .....	57
3.3	Technical Impracticability Evaluation Summary .....	60
<b>4</b>	<b>SCHEDULE.....</b>	<b>62</b>
<b>5</b>	<b>REFERENCES.....</b>	<b>63</b>

## LIST OF ATTACHMENTS

### FIGURES

Figure 1	Site Location Map
Figure 2	Property Map
Figure 3	Project Map – IAOC A18
Figure 4	2016 Aerial Photograph – IAOC A18
Figure 5	Extent of Pitch Material, EPH Exceedances in Soil and LNAPL – IAOC A18
Figure 6	Sheet Pile Wall Containment with Impermeable Cap – Existing Conditions Plan (from Revised Feasibility Study Report)
Figure 7	Sheet Pile Wall with Impermeable Cap (from Revised Feasibility Study Report)
Figure 8	Technical Impracticability Photograph Locations
Figure 9	Accessibility Limitations

### TABLES

Table 1	Analysis of Remedial Alternatives
---------	-----------------------------------

### APPENDICES

Appendix A	NJDEP Correspondence
	<ul style="list-style-type: none"> <li>• NJDEP comments on the Revised Feasibility Study Report dated April 30, 2019.</li> <li>• Summary of the June 18, 2019 meeting between representatives of ExxonMobil, Phillips 66, the LSRP, Arcadis, Kleinfelder and the NJDEP SRP and BEERA dated July 25, 2019.</li> <li>• Electronic correspondence from the NJDEP Case Manager in response to the July 25, 2019 submittal, dated August 14, 2019.</li> <li>• Response to the NJDEP’s April 30, 2019 comments on the RFSR dated August 15, 2019.</li> </ul>

## EXECUTIVE SUMMARY

---

Kleinfelder Inc. (Kleinfelder) has prepared this Technical Impracticability (TI) Report on behalf of ExxonMobil Environmental & Property Solutions Company (ExxonMobil) to demonstrate the technical impracticability associated with removal or treatment of Pitch Material and Mudflat Area soils as remedial actions for Investigative Area of Concern (IAOC) A18 at the Bayway Refinery Complex (BRC) in Linden, New Jersey. This *TI Report* has been prepared in response to certain New Jersey Department of Environmental Protection (NJDEP) comments on the August 2018 *Revised Feasibility Study Report* (RFSR) (Kleinfelder, 2018b) and subsequent correspondence between the NJDEP and the Licensed Site Remediation Professional (LSRP).

### Description of IAOC A18 (Pitch Area)

IAOC A18 includes the former Pitch Disposal Area, the Mudflat Area, the former East Retention Basin (ERB) (also referred to as the East Separator), the Heat Exchanger Cleaning (HEC) pad, and several above-ground pipelines carrying crude oil (Crude Oil Boat Lines), refinery pipelines including a portion of the Inter-Refinery Pipeline (IRPL), former Intra-Refinery Pipeline and cooling water pipeline (Salt Water Line [SWL]). Morses Creek forms the southwestern, southern and southeastern boundaries of IAOC A18. The Poly Ditch, which is an operational ditch used by the BRC to discharge non-contact cooling water, flows from northwest to southeast and enters Morses Creek at the eastern side of IAOC A18.

### Background

A RFSR for IAOC A18 was submitted to the NJDEP in August 2018 (Kleinfelder, 2018b). The RFSR evaluated several remedial alternatives for the former Pitch Disposal Area and the Mudflat Area of IAOC A18 and proposed specific remedies that, upon approval by the LSRP and the NJDEP, would be described in greater detail in a future Remedial Action Workplan (RAW). The NJDEP provided comments on the RFSR in a letter dated April 30, 2019. On June 18, 2019, a meeting between representatives of ExxonMobil, Phillips 66, the LSRP, Arcadis, Kleinfelder and the NJDEP Site Remediation Program (SRP) and Bureau of Environmental Evaluation and Risk Assessment (BEERA) was held to review the NJDEP's comments on the RFSR. A written summary of the topics discussed during the meeting and in follow-up telephone conversations between the NJDEP SRP Case Manager and the LSRP was submitted to the NJDEP on July 25, 2019. The NJDEP Case Manager responded to the July 25, 2019 submittal via electronic mail on August 14, 2019 stating that the data presented to the NJDEP in the RFSR and the June 18, 2019 meeting demonstrated the technical challenges associated with implementing certain remedial actions at IAOC A18. However, a *TI Report* and *Pilot Study Summary Report* are necessary to formally document the technical challenges and impracticability of implementing a removal or treatment remedial action for IAOC A18. A written response to the NJDEP's April 30, 2019 comments on the RFSR was submitted to the NJDEP on August 15, 2019. The NJDEP's April 30, 2019 letter

and the subsequent correspondence between the NJDEP, ExxonMobil, Kleinfelder, Arcadis, and the LSRP are included in **Appendix A**.

A *Pilot Study Summary Report* will be submitted to the NJDEP under separate cover to document the activities conducted during the Pilot Program. Additionally, a *RFSR Addendum* will be submitted to address NJDEP's comments # 3, 4, 7 and 9 from the April 30, 2019 letter which were not addressed in the August 15, 2019 response to comments.

#### Overview of NJDEP EPH Guidance and EPH concentrations in Soil in IAOC A18

EPH in IAOC A18 is classified as Category 2 EPH because Pitch Material is a crude oil distillation byproduct and because unknown petroleum hydrocarbon material is also present. Category 2 EPH derived from crude oil and unknown petroleum hydrocarbon has an EPH default product limit (DPL) of 8,000 milligrams per kilogram (mg/kg) based on the NJDEP's *Evaluation of Extractable Petroleum Hydrocarbons in Soil Technical Guidance* (EPH Guidance; NJDEP, 2019). The NJDEP's guidance document also states that EPH product determined to be immobile can have an alternative product limit greater than the EPH default product limit concentration but may not exceed the 30,000 mg/kg product "ceiling limit". Exceedances of the NJDEP EPH Category 2 DPL and the "ceiling limit" have been detected at depths ranging from the ground surface to approximately 12 feet below grade (fbg) that have not necessarily correlated to observations of light non-aqueous phase liquid (LNAPL) in those soil boring or monitoring well locations, particularly in the Mudflat Area of IAOC A18.

Multiple lines of evidence presented in the RFSR have demonstrated that EPH concentrations that exceed the NJDEP EPH Category 2 DPL of 8,000 mg/kg do not necessarily correspond to occurrences of free product in soil or ground water, and Pitch Material and LNAPL present in IAOC A18 have been determined to be functionally immobile (Kleinfelder, 2018b). However, displacement of Pitch Material at the ground surface as a result of force applied nearby has been observed. Outward displacement of Pitch Material has been observed following construction of the flood berm on the southern side of the former ERB area and following construction of the temporary access road during Pilot Program activities in 2018 and 2019.

An IAOC-specific EPH alternative product limit is not planned to be calculated for IAOC A18 because the proposed remedial action will address EPH in the IAOC regardless of the applicable EPH criteria. Therefore, for the purposes of this TI Report, in lieu of an IAOC-specific EPH alternative product limit, it is assumed that EPH soil concentrations exceeding the 8,000 mg/kg product "ceiling limit" are considered free product that require remediation in accordance with the Technical Requirements for Site Remediation (TRSR) (NJDEP, 2018b) and the NJDEP's EPH Guidance. Per the TRSR, containment of free product can only be considered where removal or treatment is not practicable.

## Remedial Alternatives Evaluation

The following general remedial strategies and technologies were evaluated in the RFSR for potential implementation to address soil and ground water impacts at IAOC A18:

- Monitored natural attenuation (MNA);
- Excavation (using conventional construction, amphibious and dredging equipment) options including
  - Full-scale excavation of the delineated extent of Pitch Material and extractable petroleum hydrocarbon (EPH) concentrations exceeding the regulatory criteria; and
  - Limited excavation (removal to a depth of approximately 2 feet of Pitch Material, Mudflat Area soils and sediment);
- Capping systems including
  - Impermeable; and
  - Reactive caps;
- Perimeter isolation/treatment including
  - Slurry wall;
  - Sheet pile wall; and/or
  - Passive reactive barrier; and
- In-situ treatment including
  - Solidification; and
  - Stabilization.

## Overview of Remedial Alternative Selection

The general remedial strategies and technologies were assembled into the following eleven (11) remedial technology and process options for evaluation:

- Long-term monitoring and release response;
- Excavation and off-site disposal of impacted materials using conventional construction equipment, amphibious equipment or dredging equipment;
- Reactive cap installation;
- Impermeable cap installation;
- Slurry wall installation;
- Sheet pile wall installation;
- Passive reactive barrier installation;
- In-situ solidification; and
- In-situ stabilization.

As presented in the RFSR, based on an evaluation of the remedial technology process options, the remedial action proposed for IAOC A18 consisted of the following containment remedy:

- Installation of sheet pile wall along the Poly Ditch and around the perimeter land surface of IAOC A18 that could be supplemented with alternate barrier technologies (e.g., jet grout, etc.) in areas where infrastructure limits access and/or ground water extraction wells to provide hydraulic control of impacted ground water.
- Potential limited excavation and offsite disposal of Pitch Material and/or Mudflat Area soils as required to: (1) accommodate grading and installation of capping materials; (2) remove Pitch Material that is contacting the SWL and to allow installation of capping materials under the SWL; and (3) maintain the required post-construction grades to support the growth of wetland plantings on the cap.
- Installation of an impermeable capping system over the Pitch Material and Mudflat Area soils – Construction of the barrier could be supplemented with alternate capping technologies (e.g. spray-applied membrane liner, or similar materials) beneath the refinery infrastructure and around the structural supports.
- Installation of a hydraulic control system consisting of groundwater recovery wells, groundwater recovery pumps, piping, infrastructure and treatment (as applicable) to prevent mounding of groundwater upgradient of the hydraulic barrier wall and prevent migration of LNAPL and dissolved contaminants in groundwater to the surface water bodies through gaps in the barrier wall at utility crossings.

In addition to the proposed remedial actions listed above, the following institutional controls would be implemented for IAOC A18:

- A Deed Notice to identify the location of remaining exceedances in soil above the NJDEP Residential Direct Contact Soil Remediation Standards (RDCSRS) and restricting the property to non-residential use; and
- The existing Classification Exception Area (CEA) which was approved by the NJDEP on July 22, 2015 to address ground water that does not meet the NJDEP Class II-A Ground Water Remediation Standards (GWRS) or site-specific Class III-B Ground Water Quality Criteria (GWQC).

A Pilot Program is ongoing to refine the constructability evaluation and evaluate site-specific implementation logistics. Details regarding the Pilot Program data collection locations, procedures, and analytical methods, as well as associated results will be included in the forthcoming *Pilot Study Summary Report*. Additionally, the Pilot Program results will establish the basis for the conceptual design of the selected remedy. Following approval of this *TI Report* by the NJDEP, a RAW which will include a conceptual design for the selected remedy will be prepared and submitted to the NJDEP.



## Applicable NJDEP Regulations and Guidance

Several NJDEP regulations and guidance were used to evaluate the technical impracticability of removal or treatment remedial action alternatives. Key statements from the regulations and guidance with underlining of select excerpts for emphasis are presented below:

- **NJDEP's *Evaluation of Extractable Petroleum Hydrocarbons in Soil Technical Guidance* (NJDEP, 2019)**

*...The Department recognizes that compliance with the EPH product limit may be impracticable for meeting the requirement at N.J.A.C. 7:26E-5.1(e) to treat or remove free product or residual product at large or complex non-residential sites. For the purposes of this technical guidance, large sites would consist of refineries and petroleum storage facilities that extend over multiple acres with multiple AOCs...*

*...For these types of sites, the investigator is advised to seek consultation with the Department before proceeding with a determination of impracticability or making a final decision on a remedial action. The typical variation for these types of sites may involve long-term remedial actions that may delay full compliance with the requirement to treat or remove free product and residual product, or it may involve remedial actions that include some form of containment and active remedial actions for soil or other media...*

*...There are circumstances where it may be technically impracticable to completely remediate free product and residual product to the applicable EPH product limit in soil. Common impediments are physical obstacles that inhibit or preclude accessibility to the product. It is contingent upon the investigator to evaluate both removal and treatment options before acceding it is technically impracticable to remediate free product and residual product, and to include a description of the evaluations used to conclude technical impracticability in the applicable remedial phase report...*

- **1993 USEPA guidance document, *USEPA Office of Solid Waste and Emergency Response Directive 9234.2-25* as referenced in the NJDEP's *Technical Impracticability Guidance for Groundwater***

*...a TI determination involves a consideration of engineering feasibility and reliability in attaining media cleanup standards, as well as situations where remediation may be technical possible, but the scale of the operations required may be of such magnitude and complexity that the remedial alternative would be impracticable.*

The applicable information that supports compliance with the regulations and guidance is provided throughout this *TI Report*.

## Technical Impracticability Considerations

Multiple factors support the determination that a removal or treatment remedial alternative for IAOC A18 is technically impracticable. Factors evaluated in this *TI Report* include: third party ownership and active refinery infrastructure; physical characteristics of surface and subsurface; surface water; and air emissions. The removal and treatment remedial action scenarios developed to evaluate the technical impracticability are summarized below:

### Removal Remedial Action Scenario

A removal remedial action scenario would consist of full-scale excavation of impacted Pitch Material and impacted soil to the extent delineated and replacement with clean material. For the purposes of this technical impracticability evaluation, removal would consist of excavation to the delineated extent of the detected EPH concentrations in soil that exceed the EPH product “ceiling limit” to depths up to approximately 12 fbg in IAOC A18.

To facilitate excavation to this depth, an excavation support system would be needed to hold back the adjacent Morses Creek surface water and sediments and protect refinery infrastructure in the area. Considering the active refinery infrastructure (SWL, IRPL, and Crude Oil Boat Lines) and safe off-sets required to protect the integrity of the infrastructure, Pitch Material and impacted soils within the safe offsets of the infrastructure cannot be removed and therefore need to remain in place. The physical characteristics of the surface and subsurface limit the size of equipment able to access the work area and increase the complexity of implementation of the project due to extensive subsurface improvement that would be needed to facilitate access. Additionally, dewatering of the excavation would be required and the surface water variability resulting from tidal influence would increase the complexity of construction and create potential loss-of-life worker safety hazards. Further, excavation and exposure of the Pitch Material and impacted soil across IAOC A18 would generate greater air emissions and nuisance odor concerns than a capping/containment remedy, potentially threatening worker safety and the public due to the proximity of the work area to the New Jersey Turnpike. These factors are further discussed below.

A removal remedial action consisting of full-scale excavation is not considered technically practicable. However, limited excavation of Pitch Material and impacted soils at certain locations may be implemented as necessary to facilitate the installation of the proposed capping/containment remedy.

### Treatment Remedial Action Scenario

A treatment remedial action scenario would consist of In-situ Soil Stabilization (ISS) to immobilize the contaminants. ISS bench-scale studies were performed by TRC and Kleinfelder and the results were presented in the *Feasibility Study Report* (FSR; TRC, 2014d) and RFSR (Kleinfelder,

2018b), respectively. The results of both ISS bench-scale studies indicated that this was not a viable remedial alternative because the volume of the treated soil approximately doubled when amended with the selected ISS reagents. This increase in volume could impose lateral forces on the supports of the SWL, Crude Oil Boat Lines and IRPL in the subsurface, which could lead to displacement of the supports and failure of the refinery infrastructure. The impacted subsurface materials beneath and within the safe offsets of the refinery infrastructure would not be accessible to the equipment that would be needed to implement an ISS remedy. In addition to the risks to active refinery infrastructure, ISS is not a viable remedial alternative because Pitch Material and LNAPL are not compatible with ISS reagents that are used to stabilize or solidify soil and the results of the bench-scale studies indicate that certain contaminants may still be leachable after treatment. Furthermore, LNAPL could be mobilized in the subsurface by implementing ISS and leaching of contaminants from treated soil could result in ongoing impacts to groundwater. The peat layer beneath IAOC A18 is a potential “sink” for ISS reagents applied. Because the peat layer extends beneath the majority of IAOC A18, ISS reagents applied may be transported through this highly permeable layer to other areas of the IAOC, or potentially to the adjacent water bodies. Additionally, ISS reagents do not effectively treat soils with a high organic content, such as the peat layer beneath IAOC A18, unless they are added in quantities that result in significant volume increases, as was observed in the two bench scale studies described above.

The following key site-specific factors will affect any remedial actions implemented for IAOC A18. This *TI Report* presents a detailed evaluation of how these factors increase the magnitude and complexity of removal or treatment remedial actions to support the technical impracticability of implementing such actions for IAOC A18:

- Third Party Ownership and Active Refinery Infrastructure: The BRC is owned and operated by Phillips 66 and critical active refinery infrastructure is located within IAOC A18 that limits or eliminates access for the removal or treatment of Pitch Material and impacted soils and presents loss-of-life worker safety risk associated with remedial action implementation. Therefore, the need to protect active refinery infrastructure and worker safety supports that removal or treatment remedial actions are technically impracticable.
- Physical Characteristics of Surface and Subsurface: The physical characteristics of the Pitch Material, Mudflat Area soils, and underlying meadow mat material create constructability challenges for remedial action implementation. The conditions either limit the size of equipment required for remediation or require extensive surface and subsurface improvement to facilitate access. The equipment and access limitations increase the magnitude and complexity of remedial action implementation supporting that removal or treatment remedial actions are technically impracticable.
- Surface Water: The surface water bodies adjacent to or within IAOC A18 are tidally influenced water bodies used by Phillips 66 as operational areas of the BRC. These water bodies restrict access, create constructability challenges, and present loss-of-life worker safety risks associated with remedial action implementation. These

challenges increase the magnitude and complexity of removal and treatment remedial action implementation supporting technical impracticability.

- Air Emissions: Potential air emissions that may result from removal or treatment remedial action implementation could cause exposure to workers and the public due to the proximity of the NJ Turnpike. The size and scope of air emission controls that would be required for removal or treatment remedial action implementation increases the magnitude and complexity of the project supporting technical impracticability.

### Selected Remedy Overview

The RFSR proposed the selected remedy as a containment remedy consisting of perimeter sheet pile barrier wall, impermeable cap, and groundwater recovery to maintain hydraulic control. Offsite migration of LNAPL is not generally a concern for IAOC A18 as LNAPL has been demonstrated to be functionally immobile in the subsurface (Kleinfelder, 2018b). Consistent with the LSRP- and NJDEP-approved *Remediation Strategy Road Map* (Road Map; Kleinfelder, 2018a), capping and containment remedial actions similar to those proposed for IAOC A18 have been implemented at other IAOCs at the BRC because these remedial actions provide a similar level of protection for public health, safety and the environment.

A capping/containment remedy would encounter some of the same challenges associated with a removal or treatment remedial action. However, as demonstrated in this *TI Report*, a capping/containment remedy presents fewer risks to worker and public health and fewer risks of damage to refinery infrastructure or any associated environment impacts. For these reasons, a capping containment remedial action is considered more feasible to implement at IAOC A18, as compared to removal or treatment remedial actions which are technically impracticable.

# 1 INTRODUCTION

---

Kleinfelder has prepared this *TI Report* on behalf of ExxonMobil to demonstrate the technical impracticability of removal or treatment remedial action in IAOC A18.

## 1.1 Purpose and Scope

A RFSR which proposed remedial actions for IAOC A18 was submitted to the NJDEP in August 2018 (Kleinfelder, 2018a). The NJDEP provided comments on the RFSR in a letter dated April 30, 2019 (**Appendix A**). On June 18, 2019, a meeting between representatives of ExxonMobil, Phillips 66, the LSRP, Arcadis, Kleinfelder and the NJDEP SRP and BEERA was held to review the NJDEP's comments on the RFSR. A written summary of the topics discussed during the meeting and in follow-up telephone conversations between the NJDEP SRP Case Manager and the LSRP was submitted to the NJDEP on July 25, 2019 (**Appendix A**). The NJDEP Case Manager responded to the July 25, 2019 submittal via electronic mail on August 14, 2019 stating that the data presented to the NJDEP in the RFSR and the June 18, 2019 meeting demonstrated the technical challenges associated with implementing certain remedial actions at IAOC A18. However, a *TI Report* and *Pilot Study Summary Report* are necessary to formally document the technical impracticability of implementing a removal or treatment remedial action for IAOC A18. A written response to the NJDEP's April 30, 2019 comments on the RFSR was submitted to the NJDEP on August 15, 2019 (**Appendix A**).

This *TI Report* has been prepared to document the technical impracticability considerations associated with implementing removal or treatment remedial actions in IAOC A18. A *Pilot Study Summary Report* will be submitted to the NJDEP under separate cover to document the activities conducted during the Pilot Program. Additionally, a *RFSR Addendum* will be submitted to address NJDEP's comments # 3, 4, 7 and 9 from the April 30, 2019 letter which were not addressed in the August 15, 2019 response to comments.

## 1.2 Site Setting

The BRC is located in Linden, New Jersey. IAOC A18 is located to the west of the New Jersey Turnpike in Unit A of the BRC (**Figures 1 and 2**). IAOC A18 includes the former Pitch Disposal Area, the Mudflat Area, the former ERB, the HEC pad, and several above-ground pipelines including the Crude Oil Boat Lines, IRPL and SWL. IAOC A18 is bounded to the southwest, south and southeast by Morses Creek. The Poly Ditch flows through IAOC A18 and into Morses Creek. IAOC features are shown on **Figure 3** and an aerial photograph of IAOC A18 from 2016 is included as **Figure 4**. Detailed descriptions of the areas within IAOC A18, infrastructure and water bodies are included in the following subsections.

### 1.2.1 Former Pitch Disposal Area

The former Pitch Disposal Area is an approximately 4-acre area in the northern portion of IAOC A18 (**Figure 3**). Aerial photographs indicate that the former Pitch Disposal Area was

filled with a variety of unknown materials between 1940 and 1961. This area is considered an undefined waste disposal area. A 1940 aerial photograph indicates that the area currently known as the former Pitch Disposal Area was partitioned by berms. The partitioned sections close to the ERB were filled with a dark material, while the sections near the Poly Ditch contained standing water. A historical map from 1941 shows that one of the partitioned sections near to the Poly Ditch was called a “Pits Area”. Some additional filling also occurred in this area in conjunction with the construction of the IRPL, SWL and Crude Oil Boat Lines that cross IAOC A18. The exact years during which Pitch Material was disposed in this area are unknown, but a 1955 geotechnical investigation found that “3- to 13.5- foot thick accumulations of semi-liquid pitch” were present (Geraghty & Miller, 1993). Pitch or Pitch Material is a low-volatility, dark viscous material (similar in composition to asphalt), containing a high percent of inert material (typically has >80% solids content), formed as a residue in the batch distillation of petroleum. During recent investigation activities, Pitch Material has been detected at thicknesses of up to 8 feet and is underlain by meadow mat at depths ranging from approximately 8 to 14 fbg. The greatest thicknesses of Pitch Material have generally been detected in the western portion of the former Pitch Disposal Area. Pitch Material is present beneath active refinery infrastructure including the SWL and IRPL. Pitch Material thickness generally decreases toward the eastern side of the former Pitch Disposal Area. Pitch Material is present beneath active refinery infrastructure (the SWL and IRPL).

#### 1.2.2. Mudflat Area

The Mudflat Area is an approximately 12-acre area within IAOC A18 that extends to the southeast from the former Pitch Disposal Area (**Figure 3**). The Mudflat Area is bounded by Moses Creek and the Poly Ditch. The SWL and Crude Oil Boat Lines transect portions of the Mudflat Area. The Mudflat Area was identified as the “Boat Lines Dredgings Area” on a historical map and a 1940 aerial photograph indicated that this area may have been filled with dredge spoils from Moses Creek prior to 1940 (Geraghty & Miller, 1993). The SWL is present at approximately the boundary between the Mudflat Area and the former Pitch Disposal Area, although the Mudflat Area extends to the north of the SWL at the eastern side of IAOC A18. Pitch Material has been observed as sporadic, non-contiguous deposits, usually at the surface, within the Mudflat Area. The Mudflat Area is generally inundated by surface water from Moses Creek and the Poly Ditch twice per day during half of the lunar cycle. The Mudflat Area soil consists of former dredge spoils from Moses Creek and is underlain by meadow mat at depths ranging from approximately 2 to 14 fbg.

#### 1.2.3 Area East of the Poly Ditch

Soil and subsurface conditions in the area of IAOC A18 located to the east of the Poly Ditch are generally consistent with those found in the Mudflat Area to the west of the Poly Ditch. However, this area is considered separately from the Mudflat Area because it is physically separated from the rest of the IAOC by the Poly Ditch and Pitch Material has not been observed in this area of IAOC A18. This area is constrained by the Poly Ditch, Moses Creek,



the SWL, and the Crude Oil Boat Lines (**Figure 3**). Based on historical remedial investigations and documentation, this area was thought to not be impacted by Pitch Material due to:

- The presence of the Poly Ditch prior to 1940 (as shown in historical aerial photographs); and
- Construction of the pipelines and initiation of disposal practices of the Pitch Material in the 1940s (Geraghty & Miller, 1993).

Pitch Material was not observed in soil borings advanced via hand auger to the east of the Poly Ditch during the period of September 28, 2015 through October 17, 2016 and September 20, 2018 to September 21, 2018, which confirmed that the area of IAOC A18 located east of the Poly Ditch had not been subjected to Pitch Material disposal practices.

#### 1.2.4 Refinery Infrastructure

IAOC A18 is located in an active, operating area of the BRC. Refinery infrastructure located within IAOC A18 includes the former ERB, the HEC, Crude Oil Boat Lines, IRPL, and SWL. The refinery infrastructure is described in this section.

##### Former ERB

The former ERB was an approximately 40,000 square foot, in-ground concrete basin constructed in 1908. The ERB operated until 2014 as one of two primary treatment oil/water separators for the BRC process areas and tank fields in Unit A. The ERB stored process water and storm water from process facilities in the Gasoline Blending Tank Field and the East Side Chemical Plant. Non-hazardous substances such as unleaded gasoline tank bottoms were also stored in two bays of the ERB which did not handle wastewater. Periodically, outside services were contracted to dewater the solids collected in the ERB and dispose of them off-site. The liquids received by the ERB were transferred to the West Separator for additional treatment. During a major storm, however, wastewater and storm water in the ERB could be discharged to Morses Creek via a bypass (Geraghty & Miller, 1993). Such an event occurred during Superstorm Sandy in October and November 2012 when the ERB overflowed. The ERB was decommissioned in 2015. The ERB was steam-cleaned and then backfilled with material from an onsite source to match the surrounding ground surface.

##### HEC Pad

Beginning in approximately 1974, a concrete pad located to the south of the IRPL and to the east of the ERB Basin, was used for storing barrels. The concrete pad was later used for cleaning heat exchanger tube bundles and became known as the HEC pad (Geraghty & Miller, 1993). The HEC pad is currently used as a storage and materials lay-down area by Phillips 66.

## Crude Oil Boat Lines

The Crude Oil Boat Lines carry crude oil from the Waterfront Area through the eastern portion of IAOC A18 to the Tremley Tank Field which is located to the southwest of IAOC A18. These lines extend from northeast to southwest across both the areas east and west of the Poly Ditch. The Crude Oil Boat Lines extend across the Poly Ditch and Morses Creek. A 1940 aerial photograph shows construction fill placed along the base of the Crude Oil Boat Lines. A 1941 aerial photograph describes the “Boat Lines Dredgings Area” as Spoil Area No. 4. Some filling may have occurred in subsequent years when the Crude Oil Boat Lines were expanded and when bulkheads were constructed along the shore of Morses Creek (Geraghty & Miller, 1993).

## IRPL

The northern section of the IAOC A18 adjacent to the Butane and Propane Caverns Area (IAOC A17) was filled by 1951 in preparation for the construction of the caverns and several pipelines including the IRPL, and a high-pressure steam line. By 1961 the IRPL, which traverses the boundary between IAOC A17 and IAOC A18, was constructed. Fill for the construction of the IRPL and adjacent access roads may have come from the excavation of the Butane and Propane Caverns in 1958 (Geraghty & Miller, 1993). The Intra-Refinery Pipeline, which extended from the BRC to ExxonMobil’s Bayonne Terminal was formerly part of the IRPL. The pipeline extending from the BRC to the Bayonne Terminal was taken out-of-service in approximately 1990 but the IRPL is currently active and is used to transfer materials within the BRC. Pitch Material has been observed and LNAPL has been detected in monitoring well GMW-692 which is located within the rectangular area formed by the various pipelines of the IRPL.

## SWL

The SWL is a 60-inch diameter bell-and-spigot cast iron pipeline that was constructed in approximately 1947 (Geraghty & Miller, 1993). The SWL is supported on timber piles, some of which have been reinforced with concrete pile caps by Phillips 66. The SWL carries saltwater from the Arthur Kill to the BRC for use as non-contact cooling water at a rate of approximately 160,000 gallons per minute. The SWL extends from east to west across northern portions of the area east of the Poly Ditch, the Poly Ditch, the Mudflat Area and the former Pitch Disposal Area within IAOC A18. At the eastern side of IAOC A18, the SWL is elevated approximately 2 to 3 feet above the Mudflat Area surface. As the SWL extends to the west, the Mudflat Area and former Pitch Disposal Area surface elevation rises and the bottom of the SWL is in contact with Pitch Material and Mudflat Area soils in the central and western portion of IAOC A18. The SWL restricts access to the area to the south of the line. The area to the south of the SWL is currently accessible on foot via a scaffold that has been constructed over the line, but this area is not accessible from the north by vehicles or motorized equipment.

### 1.2.5 Morses Creek

Morses Creek forms the southwestern, southern and southeastern boundaries of IAOC A18. Morses Creek is a tidal water body from No. 1 Dam to the confluence with the Arthur Kill. No. 1 Dam is the head of tide for the BRC. Upstream of No. 1 Dam including adjacent to IAOC A18, Morses Creek is tidally influenced, but is not considered a tidal water body. As the tidal elevation rises, surface water discharge from Morses Creek at No. 1 Dam is restricted, influencing the surface water elevation of Morses Creek. Surface water inundates the Mudflat Area surface twice a day during half of the lunar cycle during the periods of restricted surface water flow. Morses Creek is thermally impacted by process and non-contact cooling water discharges, with summer temperatures exceeding 90 degrees Fahrenheit (TRC, 2014b).

### 1.2.6 Poly Ditch

The Poly Ditch is an operational ditch used by the BRC to discharge non-contact cooling water. The Poly Ditch flows from northwest to southeast and enters Morses Creek at the eastern side of IAOC A18. The Poly Ditch transects IAOC A18 and restricts access to the easternmost portion of the IAOC. Like Morses Creek, the Poly Ditch is tidally-influenced but it is not considered a tidal water body. As the tidal elevation rises in the Arthur Kill, surface water discharge from Morses Creek at No. 1 Dam is restricted influencing the surface water elevation of Morses Creek and the Poly Ditch.

In April 2018, Keller and Kirkpatrick of Morris Plains, New Jersey (K&K), a New Jersey Certified Professional Land Surveyor, completed a bathymetric survey of the Poly Ditch. Surveying was conducted across the Poly Ditch from the top of bank on one side to the top of bank on the opposite side at various locations from the northern extent of the Poly Ditch to the confluence at Morses Creek. The bathymetry data indicated that the Poly Ditch ranged from approximately 2-feet to approximately 6-feet below the top of the banks. The data from the survey will be included in the Pilot Program Completion Report, which will be submitted under separate cover.

## 1.3 Regulatory Background

The following subsections include a brief summary of the regulatory background of the BRC and IAOC A18.

### 1.3.1 BRC-Wide Background

In accordance with the Administrative Consent Order, ExxonMobil conducted a remedial investigation (RI) at the BRC. Detailed information regarding the history of the BRC, operations and spills is contained within the *Site History Report* (Geraghty & Miller, 1993), *Phase 1A Remedial Investigation Interim Report* (Geraghty & Miller, 1995), *Supplemental Remedial Investigation Report* (Arthur D. Little, 1997), *Bayway Phase 1B Remedial*

*Investigation Report* (Arthur D. Little, 2000), and *Bayway Refinery Phase 2 Remedial Investigation Report* (TRC Raviv, 2004b).

A *Supplemental Site-Wide Remedial Investigation Workplan* (SSWRIWP) was submitted in April 2012 (TRC, 2012a) to propose the additional RI work for IAOC A18, as well as other areas that required additional investigation within the BRC. The SSWRIWP for IAOC A18 was based on the NJDEP's comments and the data collected between 1996 and 2004. The SSWRIWP was approved by the NJDEP on May 1, 2013. The results of the additional investigation, which were presented in the *Supplemental Site-Wide Remedial Investigation Report* (SSWRIR; TRC, 2014c), indicated that additional investigation was not warranted for soil or ground water in IAOC A18 (TRC, 2014c). The NJDEP issued a letter dated May 7, 2014 acknowledging that the RI at the BRC was complete and met the statutory requirement (NJDEP, 2014b). The NJDEP subsequently issued comments regarding the SSWRIR. A response to the NJDEP's comments was submitted on October 10, 2014. The NJDEP approved the SSWRIR and the Responses to NJDEP Comment Letter on September 21, 2015 (NJDEP, 2015a).

The LSRP program was established in New Jersey as part of the Site Remediation Reform Act, N.J.S.A. 58:10C-1 *et seq.* (SRRA; State of New Jersey, 2019), which was signed into law on May 7, 2009. Recent and ongoing changes in NJDEP regulations and guidance have necessitated revisiting the BRC's remedial strategy in order to maintain ongoing compliance. ExxonMobil was informed by NJDEP that because the BRC is on the United States Environmental Protection Agency's (USEPA's) RCRA Government Performance and Results Act (GPRA) 2020 corrective action list of high priority facilities, NJDEP approval of remedial action work plans will be required in addition to the LSRP approval. The BRC remains under traditional NJDEP oversight in conjunction with LSRP oversight. The NJDEP Traditional Oversight Report Certification Form is provided at the beginning of this report.

The Remedial Strategy Road Map (Road Map) summarizes a decision framework developed between the LSRP, the NJDEP and ExxonMobil to manage remediation within the BRC and was the product of several meetings between the NJDEP and ExxonMobil. The Road Map was first submitted to the NJDEP in November 2011 (TRC, 2011). Five revisions to the Road Map have been submitted as follows:

- Revision 1.0 was submitted in June 2012 (TRC, 2012b);
- Revision 2.0 in September 2013 (TRC, 2013d);
- Revision 3.0 in July 2014 (TRC, 2014e);
- Revision 4.0 in September 2016 (TRC, 2016); and
- Revision 5.0 in March 2018 (Kleinfelder, 2018a).

The most recent version of the Road Map (Revision 5.0) was approved by the NJDEP on December 10, 2018 (NJDEP, 2018d). IAOC A18 is identified in the Road Map as both "Category 1 - Operating, storage or handling area" and "Category 2 - Open land, closed or

inactive area” in the Road Map. The remedial alternative proposed in the RFSR is consistent with the following remedial strategies for Category 1 areas at the BRC:

#### Soil

- Waste areas contained and capped;
- “Hot spot” removal and/or capping in dredge spoils areas;
- Remediation to address ecological exposures in wetland areas; and
- Response Action Outcome (RAO) and Remedial Action Permit for Soil.

#### Ground water

- Ground water contained and treated at the IAOC perimeter, or transferred to the BRC’s waste water treatment plant (WWTP) for treatment;
- Alternate ground water standards to be applied in Class III-B areas;
- RAO and Remedial Action Permit for Ground Water (typically after one year of remediation system operation, as applicable)

#### Free product

- Free product will be removed, treated and/or contained to the extent practicable.

The remedial alternative proposed in the RFSR is consistent with the following remedial strategies for Category 2 areas at the BRC:

#### Soil

- Remediation based on worker exposure (acute exposures, direct contact, Immediate Environmental Concern [IEC], Occupational Safety and Health Association [OSHA] thresholds); and
- Establish engineering and institutional controls.

#### Ground water

- Perimeter control (includes capture and/or treatment) consistent with long-term remediation;
- Alternate ground water standards to be applied in Class III-B areas; and
- Remedial monitoring and evaluation (perimeter and receptor).

#### Free product

- Mobile product discharging to surface waters or migrating off-site addressed with containment and/or active removal and/or treatment systems;
- Mobile product not impacting surface waters addressed with perimeter control/containment;

- Immobile product which is acting as a source of ground water impacts may be subject to perimeter control/containment and/or natural remediation; and
- Immobile product which is not acting as a source of ground water impacts may be subject to monitoring only.

It should be noted that in various correspondence, the NJDEP has stated that Pitch Material is considered to be free product. The remedial actions proposed for IAOC A18 in the RFSR are consistent with the criteria for Category 1 and Category 2 areas, including the criteria for addressing free product, described in the Road Map.

### 1.3.2 IAOC A18 Regulatory and Environmental Background

The results of the Feasibility Study and historic RI data collected in IAOC A18 from 1993 through 2013 were reported in the July 25, 2014 Feasibility Study Report (FSR; TRC, 2014d). The NJDEP provided comments on the July 2014 FSR in a letter dated October 10, 2014 (NJDEP, 2014d).

*A Pre-Design Investigation (PDI) Work Plan for Pitch Area Investigative Area of Concern (IAOC) A18 – Bayway Refinery Complex, Linden, New Jersey* (PDI Work Plan) was submitted to the NJDEP on January 29, 2015 (Kleinfelder, 2015). The NJDEP provided comments on the January 2015 PDI Work Plan on March 9, 2015 (NJDEP, 2015b). *A Response to NJDEP's March 9, 2015 Comments on the Pitch Area Investigative Area of Concern A18 Pre-Design Investigation Work Plan* was submitted to the NJDEP on July 15, 2015 (ExxonMobil, 2015). The NJDEP approved the January 29, 2015 PDI Work Plan and the Response to NJDEP's March 9, 2015 Comments on the PDI Work Plan in a letter dated July 27, 2015 (NJDEP, 2015c).

PDI activities were initiated following the NJDEP's approval of the January 29, 2015 PDI Work Plan. The purpose of the PDI activities was to supplement existing data for IAOC A18 in support of remedial action evaluation and selection for this IAOC. Phase I of the PDI activities included the following:

- Investigation of the physical and chemical characteristics, as well as extents of Pitch Material and LNAPL;
- A ground water investigation consisting of a surface water inundation study and hydraulic conductivity evaluation;
- A geotechnical and structural investigation of the SWL and supporting elements and an evaluation of settlement due to capping loads;
- An evaluation of the potential for vapor generation during remedial activities; and
- A waste management evaluation.

On April 22, 2016, a meeting between representatives of the NJDEP, ExxonMobil, Kleinfelder, Phillips 66 and the LSRP was held to update the NJDEP on the progress of the PDI activities and to outline the plan for supplemental PDI activities that were not originally included in the PDI Work Plan. In an electronic mail dated April 26, 2016, the NJDEP stated that a Supplemental



PDI Work Plan was not required, and that the April 22, 2016 presentation was sufficient to proceed with the supplemental PDI (NJDEP, 2016).

Phase II of the PDI activities was initiated to supplement historical data for IAOC A18 and the findings of Phase I of the PDI in support of remedial action evaluation and selection for IAOC A18. Phase II of the PDI activities included the following:

- Additional investigation of the extent of Pitch Material at the northern portion of the former Pitch Disposal Area;
- Updating the LNAPL conceptual site model;
- A supplemental ground water assessment;
- Evaluation of potential beneficial use of Pitch Material as an alternative to disposal;
- A constructed wetland feasibility assessment;
- A constructability evaluation of conceptual remedial approaches with qualified contractors;
- Supplemental geotechnical borings and numerical modeling to evaluate potential excavation support options;
- Supplemental ground settlement modeling based on anticipated loads from conceptual cap designs; and
- A bench-scale in-situ stabilization/solidification (ISS) treatability study.

On October 25, 2017, a meeting between representatives of the NJDEP, ExxonMobil, Phillips 66, Arcadis, Kleinfelder and the LSRP was held at the NJDEP's office to provide a summary of the Supplemental PDI results and to propose Pilot Program activities to address design data gaps.

On January 24, 2018, a meeting between representatives of the NJDEP Division of Land Use Regulation (DLUR) and Flood Hazard Group, ExxonMobil, Phillips 66, Arcadis, Kleinfelder and the LSRP was held onsite at IAOC A18 to review permitting requirements and potential permitting issues associated with upcoming Pilot Program activities. During this meeting, the NJDEP DLUR indicated that a net fill of the Mudflat Area with a hardship exception could be considered.

The results of the PDI and Supplemental PDI activities were presented in the RFSR which was submitted to the NJDEP in August 2018. The RFSR evaluated several remedial alternatives for the former Pitch Disposal Area and the Mudflat Area of IAOC A18 and proposed specific remedies that, upon approval by the LSRP and the NJDEP, would be described in greater detail in a future RAW. The NJDEP provided comments on the RFSR in a letter dated April 30, 2019 (**Appendix A**). On June 18, 2019, a meeting between representatives of ExxonMobil, Phillips 66, the LSRP, Arcadis, Kleinfelder and the NJDEP SRP and BEERA was held to review the NJDEP's comments on the RFSR. A written summary of the topics discussed during the meeting and in follow-up telephone conversations between the NJDEP SRP Case Manager and the LSRP was submitted to the NJDEP on July 25, 2019 (**Appendix A**). The NJDEP Case Manager

responded to the July 25, 2019 submittal saying that the data presented to the NJDEP in the RFSR and the June 18, 2019 meeting demonstrated the technical challenges. However, a *TI Report* and *Pilot Study Summary Report* are supporting documents to the RFSR which are necessary to demonstrate the technical challenges of IAOC A18. The NJDEP could not concur that the technical challenges are sufficient to support the remedy proposed in the RFSR without the *TI* and *Pilot Study Summary Reports*. A written response to the NJDEP's April 30, 2019 comments on the RFSR was submitted to the NJDEP on August 15, 2019 (**Appendix A**). This *TI Report* has been prepared to document the technical impracticability considerations associated with implementing removal or treatment remedial actions in IAOC A18. A *Pilot Study Summary Report* will be submitted to the NJDEP under separate cover to document the activities conducted during the Pilot Program. A *RFSR Addendum* will be submitted to address NJDEP's comments # 3, 4, 7 and 9 from the April 30, 2019 letter which were not addressed in the August 15, 2019 response to comments.

### 1.3.3 EPH Guidance Applicable to IAOC A18

The NJDEP's EPH Guidance categorizes EPH products as follows:

- Category 1 EPH – No. 2 heating oil and diesel fuel; and
- Category 2 EPH – No. 4. heating oil, No. 6 heating oil, hydraulic oil, cutting oil, lubricating oil, crude oil, waste oil, unknown petroleum hydrocarbons, waste vehicular crankcase oil, mineral oil, dielectric fluid, dielectric mineral oil, transformer oil, or EPH-type discharges associated with manufactured gas plant (MGP) sites.

EPH in IAOC A18 is classified as Category 2 EPH because Pitch Material is a residue generated from the batch distillation of crude oil and unknown petroleum hydrocarbons are present in IAOC A18. The guidance document states that an EPH DPL for Category 2 EPH products including crude oil is 8,000 mg/kg, which is based on an assessment of the residual saturation concentrations for various petroleum products in medium sand, which was determined to be a representative soil texture for most soil in New Jersey. If the applicable default product limit is exceeded, the EPH Alternative Product Limit Calculator can be used to calculate an IAOC-specific EPH alternative product limit. The NJDEP's guidance document also states that EPH product determined to be immobile can have an alternative product limit greater than the EPH default product limit concentration but may not exceed the 30,000 mg/kg product "ceiling limit". Exceedances of the NJDEP EPH Category 2 DPL have been detected at depths ranging from the ground surface to approximately 12 fbg that have not necessarily correlated to observations of LNAPL in soil borings or monitoring wells, particularly in the Mudflat Area of IAOC A18.

Multiple lines of evidence presented in the RFSR have demonstrated that EPH concentrations in soil that exceed the NJDEP EPH Category 2 DLP do not necessarily correspond to occurrences of free product in soil or ground water, and Pitch Material and LNAPL present in IAOC A18 have been determined to be functionally immobile (Kleinfelder, 2018b). Therefore, for the purposes of this *TI Report*, it is assumed that EPH soil concentrations exceeding the

30,000 mg/kg product “ceiling limit” are considered free product that require remediation in accordance with the TRSR (NJDEP, 2018b) and the NJDEP’s EPH Guidance. Containment of free product can only be considered where removal or treatment of free product is not practicable. An IAOC-specific EPH alternative product limit may be calculated and presented in a future submittal, if warranted.

#### 1.4 Receptors

The surface water bodies, and the ecological communities that may be supported by them, in and adjacent to IAOC A18 are considered the receptors that remedial actions are intended to protect. These water bodies include Morses Creek and the Poly Ditch. The Poly Ditch flows into Morses Creek toward the eastern side of IAOC A18. Morses Creek, in turn, flows into the Arthur Kill at the eastern boundary of the BRC.

For occupational settings where persons are in a working situation (e.g., workplaces where workers are handling hazardous chemicals, manufacturing facilities using substances similar to or different from those in the subsurface contamination, as well as other workplaces, such as administrative and other office buildings where chemicals are not routinely handled in daily activities), the OSHA and USEPA have agreed that OSHA generally will take the lead role in addressing occupational exposures (USEPA, 2003). The BRC is an active industrial complex with petroleum refining and chemical manufacturing operations. Site operations are covered by occupational regulations established by the Federal Department of Labor and OSHA. It has been conveyed to ExxonMobil that the business entities within the BRC regularly monitor their workers and contractors in accordance with OSHA requirements.

#### 1.5 Report Organization

This *TI Report* is organized as follows:

Section 1 includes the purpose and scope of the report and general background information regarding the BRC and IAOC A18.

Section 2 presents an overview of the Conceptual Site Model for IAOC A18 and a review of the remedial alternatives evaluation and remedy selection presented in the RFSR.

Section 3 presents a detailed review of the technical impracticability associated with implementing removal or treatment remedial actions at IAOC A18.

Section 4 includes a schedule for implementation of remedial actions for IAOC A18.

Section 5 lists references.

## 2 REVISED FEASIBILITY STUDY REPORT OVERVIEW

---

The RFSR (Kleinfelder, 2018b) presented a detailed site history, regulatory background, description of the applicable remedial standards applied to IAOC A18, description of the media of concern, summaries and results of PDI and Supplemental PDI activities, a conceptual site model, remedial alternatives evaluation and selection for the former Pitch Disposal Area, the Mudflat Area and IAOC ground water. Because the conceptual site model, remedial alternatives evaluation, and selected portions of the RFSR are the focus of the NJDEP's comments in the April 30, 2019 letter and are technical impracticability considerations, summaries of these sections of the RFSR are included below. **Section 2.1** presents an overview of the conceptual site model. **Section 2.2** summarizes the soil and ground water remedial action alternatives identified and evaluated in the RFSR. **Section 2.3** describes the remedy selected based on the results of the remedial action alternatives analysis.

### 2.1 Conceptual Site Model

Below is a summary of the Conceptual Site Model presented in the RFSR. The summary of the CSM is presented here to support the determination that removal or treatment of Pitch Material and impacted soil in IAOC A18 is technically impracticable.

#### 2.1.1 Nature and Extent of Pitch Material

Pitch or Pitch Material is a low-volatility, dark viscous material (similar in composition to asphalt), containing a high percent of inert material (typically has >80% solids content), formed as a residue in the batch distillation of petroleum, and refers to materials that have been disposed in the former Pitch Disposal Area located in the northern portion of IAOC A18. As indicated in the NJDEP-approved ERIR (TRC, 2014a) and *Ecological Remedial Investigation Report Addendum* (ERIRA; TRC, 2014b), Pitch Material is not mobile in the subsurface (TRC, 2014a and b). Displacement of Pitch Material at the ground surface as a result of force applied nearby has been observed. Outward displacement of Pitch Material has been observed following construction of the flood berm on the southern side of the former ERB area and following construction of the temporary access road during Pilot Program activities in 2018 and 2019.

The portion of IAOC A18 east of the Poly Ditch is constrained by the Poly Ditch, Morses Creek, the SWL, and the Crude Oil Boat Lines (**Figure 3**). This area was thought to not be impacted by Pitch Material due to:

- The presence of the Poly Ditch prior to 1940 (as shown in historical aerial photographs); and
- Construction of the pipelines and initiation of disposal practices of the Pitch Material in the 1940s (Geraghty & Miller, 1993).

During the period of September 2015 through September 2018, soil borings were advanced to refine the extent of Pitch Material in IAOC A18, to evaluate whether Pitch Material had been deposited in the area east of the Poly Ditch and to collect soil and Pitch Material samples for laboratory analyses. The results of the soil sampling events conducted during this period were detailed in the RFSR, and are summarized as follows:

- The southern, eastern and western extents of Pitch Material were refined and Pitch Material was determined to be present to the northern boundary of IAOC A18.
- Pitch Material was not observed in soil borings advanced to the east of the Poly Ditch, which confirmed that the area of IAOC A18 located east of the Poly Ditch had not been subjected to Pitch Material disposal practices.
- Hydraulic conductivity values for the Pitch Material and subsurface soil in this area reported in the July 2014 FSR ranged from  $1.8 \times 10^{-7}$  to  $8.1 \times 10^{-7}$  cm/sec. Based on this range in hydraulic conductivity, Pitch Material is immobile in the subsurface. During the hot summer months, it can become more pliable, but remains highly viscous.
- Pitch Material contains hydrocarbons that are consistent with a slightly weathered crude oil material or possibly a heavy gas oil product, and has a different composition than LNAPL detected in monitoring wells in the former Pitch Disposal Area, which indicates that Pitch Material is not the source of LNAPL detected in IAOC A18.
- At least a portion of the Pitch Material would be classified as characteristic hazardous waste for waste management and disposal purposes based on waste classification sample results. Because Pitch Material is present in sporadic non-contiguous deposits throughout the surficial soil of the Mudflat Area, at least a portion of Mudflat Area soil could also be classified as characteristic hazardous waste for waste management and disposal purposes.

The lateral extent of Pitch Material based on visual observations during historical RI activities, as well as PDI, Supplemental PDI and Pilot Program soil borings are shown on **Figure 5**.

### 2.1.2 Surficial and Subsurface Lithology

A summary of surficial and subsurface lithology in IAOC A18 based on historical investigation, PDI and Supplemental PDI activities presented in the RFSR is included below:

- Ground surface elevations in IAOC A18 decrease from approximately 10 feet above mean sea level (msl) at the northern end (near the former ERB/HEC pad/IRPL areas) to approximately 3 feet above msl at the southern end (the Mudflat Area).
- Pitch Material has been detected at thicknesses up to approximately 8 feet in the western portion of the former Pitch Disposal Area, and decreases to less than 1 foot toward the eastern side.
- Pitch Material has been observed as sporadic, non-contiguous deposits, usually at the surface, within the Mudflat Area.
- Pitch Material is present beneath active refinery infrastructure (the SWL and IRPL).
- Pitch Material in the former Pitch Disposal Area and soil in the Mudflat Area are underlain by meadow mat. Meadow mat thickness generally increases from

approximately 1 foot at the northern end of IAOC A18 (near the former ERB/HEC pad/IRPL areas) to approximately 10 feet at the southern end (the Mudflat Area).

- Below the meadow mat is a layer of alluvial deposits which generally increase in thickness from approximately 2 to 3 feet at the southern end of IAOC A18 (the Mudflat Area) to approximately 15 feet at the northern end (near the former ERB/HEC pad/IRPL areas).
- Alluvial deposits are underlain by glacial till which consists of reddish-brown silt and clay. The top of the glacial till layer is at an elevation of approximately -10 feet below msl.

### 2.1.3 Soil Exceedances

A summary of historical soil investigation activities, PDI and Supplemental PDI activities presented in the RFSR is included below:

- Analytical results of soil samples collected from IAOC A18 (historical RI activities, PDI, Supplemental PDI and Pilot Program) have been compared to the NJDEP Soil Remediation Standards (SRS) or Ecological Screening Criteria (ESC) depending on their locations relative to wetlands and transition zones. Laboratory analytical data indicated that various VOCs, semi-volatile organic compounds (SVOCs), metals and pesticide compounds have exceeded the NJDEP SRS and/or ESC in soil samples collected from both the former Pitch Disposal and Mudflat Areas of IAOC A18. Figures showing the location of exceedances of the applicable NJDEP SRS or ESC detected in historical soil samples will be included in the RFSR Addendum.
- EPH concentrations have exceeded the NJDEP Category 2 EPH DPL of 8,000 mg/kg which applies to crude oil and unknown petroleum products, and the ceiling limit of 30,000 mg/kg as specified in the NJDEP *Evaluation of Extractable Petroleum Hydrocarbons in Soil Technical Guidance* (NJDEP, 2019) in soil samples collected from the former Pitch Disposal Area, Mudflat Area and the area of IAOC A18 to the east of the Poly Ditch. Exceedances of the NJDEP Category 2 EPH DPL (8,000 mg/kg) and ceiling limit (30,000 mg/kg) are shown on **Figure 5**. As stated in **Section 1.3.3**, for the purposes of this TI Report, it is assumed that soils exceeding the 30,000 mg/kg and are considered free product that are required to be remediated in accordance with the TRSR (NJDEP, 2018b) and the *Evaluation of Extractable Petroleum Hydrocarbons in Soil Technical Guidance* (NJDEP, 2019).

### 2.1.4 LNAPL Conceptual Site Model

LNAPL has been detected in IAOC A18. A summary of historical investigation activities, PDI and Supplemental PDI activities pertaining to LNAPL which were detailed in the RFSR, and summarized below:

- LNAPL was not detected in monitoring wells located in IAOC A18 prior to December 2013. LNAPL was first observed at GMW-650 (0.26 ft) located in the former Pitch Disposal Area south of the SWL in December 2013 and GMW-211R (0.02 ft) located

in the former Pitch Disposal Area north of the SWL in April 2014 (**Figure 5** – grid cell B1).

- LNAPL was subsequently detected in five monitoring wells in IAOC A18. LNAPL has primarily been detected in monitoring wells installed within the former Pitch Disposal Area.
- The only monitoring well in the Mudflat Area that has contained LNAPL is GMW-749 which was installed during Pilot Program activities in December 2018. LNAPL has also been detected in GMW-229 which is located in IAOC A17, to the north of the former Pitch Disposal Area.
- The maximum historical LNAPL thicknesses in monitoring wells located in IAOC A18, and GMW-229 in IAOC A17 is as follows:

Monitoring Well	LNAPL Thickness (feet)	Date	Figure 5 Grid Cell
GMW-211R (abandoned)	4.89	October 17, 2016	B2
GMW-229	0.14	November 3, 2016 and February 16, 2018	B2
GMW-650	0.26	December 1, 2013	B1
GMW-688 (abandoned)	3.59	October 28, 2016	B2
GMW-689	0.03	June 27, 2017	B2
GMW-690	0.26	November 17, 2017	B2
GMW-691	3.13	November 7, 2017	B2
GMW-692	0.49	September 22, 2017	B2
GMW-748	0.84	March 29, 2019	B1
GMW-749	0.08	June 5, 2019	B2
L-16A	0.31	March 1, 2013 (Reported in FSR; TRC, 2014d)	B1

- While the specific source of LNAPL in IAOC A18 remains unknown, samples of LNAPL from GMW-650 and GMW-211R do not appear to be from the same source.
- Although the results of the chromatographic fingerprinting analyses indicated that LNAPL and Pitch Material were similar in composition, the source of LNAPL in monitoring wells in IAOC A18, and GMW-229 in IAOC A17, has not been determined.
- Minor amounts of automotive gasoline have been detected in LNAPL samples from GMW-650 and GMW-211R. A possible explanation for the presence of minor amounts of automotive gasoline in these samples could be flooding caused by Superstorm Sandy in October 2012, which may have allowed gasoline or other refined petroleum product to be transported to IAOC A18.
- The LNAPL saturation profile data collected during Supplemental PDI activities indicates that LNAPL saturations are highest (16.0% to 45.9% of pore volume [pv]) in the intervals containing Pitch Material and decreased with depth beneath the Pitch Material (<0.1 to 9% pv).

- LNAPL detected in GMW-749 is not believed to be the result of LNAPL migration from the former Pitch Disposal Area. Rather LNAPL is believed to be present in GMW-749 as a result of forces applied to the subsurface by the installation of the temporary access road during the Pilot Program. Residual LNAPL may have already been present in the area of GMW-749, likely within the meadow mat layer, but was immobile under the forces present in the subsurface prior to the start of the Pilot Program. When the temporary access road was constructed, compression of the underlying strata resulted in localized displacement of LNAPL as evidenced by the LNAPL detections in GMW-749 beginning approximately 6 months after installation of this well. It should be noted that LNAPL has not been detected in GMW-138 which is located adjacent to the Poly Ditch, at the eastern end of the temporary access road near GMW-749 indicating that LNAPL is not migrating to the Poly Ditch.

#### 2.1.5 Ground Water to Surface Water Migration Pathway

Ground water investigation activities have included ground water sampling, hydraulic conductivity evaluation and metals speciation modeling. A summary of historical ground water and surface water investigation activities, PDI and Supplemental PDI activities presented in the RFSR is included below:

- Ground water sampling has been conducted at IAOC A18 since 1993. Analytical results of the ground water samples were compared to the NJDEP Class II-A GWRS, site-specific Class III-B GWQC or ESC depending on their locations relative to the Class II-A GWRS /Class III-B GWQC boundary and surface water bodies. Various VOCs, SVOCs and metals exceeded the applicable NJDEP Class II-A GWRS, site-specific Class III-B GWQC or ESC.
- Hydraulic conductivity evaluations consisted of rising and falling head permeability (slug) testing conducted on monitoring wells GMW-686 and GW-687 in the Mudflat Area and GMW-689 and GMW-690 in the former Pitch Disposal Area of IAOC A18. The hydraulic conductivity values for GMW-689 (0.1 feet per day) and GMW-690 (0.7 feet per day) which are screened in intervals containing Pitch Material, silty clay, sandy silt and fill material are lower than those of GMW-686 (1.1 feet per day) and GMW-687 (1.5 feet per day) which are partially screened in the highly permeable peat/meadow mat layer.

Lead and arsenic concentrations in ground water in IAOC A18 have historically exceeded the NJDEP Class II-A GWRS and site-specific Class III-B GWQC. The results of a simulated reactive geochemical transport model indicated that arsenic and lead in ground water remain in the dissolved aqueous state and do not precipitate as ground water approaches Morses Creek.

#### 2.1.6 Surface Water Inundation

A summary of surface water inundation in IAOC A18 is included below:



- Morses Creek forms the southwestern, southern and southeastern boundaries of IAOC A18.
- Morses Creek is a tidal water body from No. 1 Dam to the confluence with the Arthur Kill. No. 1 Dam is the head of tide for the BRC. Morses Creek is tidally-influenced but not considered a tidal water body upstream of No. 1 Dam, including adjacent to IAOC A18.
- As the tidal elevation rises in the Arthur Kill, surface water discharge from Morses Creek at No. 1 Dam is restricted influencing the surface water elevation of Morses Creek and the Poly Ditch.
- Surface water inundates the Mudflat Area of IAOC A18 surface twice a day during half of the lunar cycle during the periods of restricted surface water flow.

Details of the surface water inundation evaluation were presented in the RFSR (Kleinfelder, 2018b). The effects of surface water inundation on construction and remediation activities in IAOC A18 is discussed in **Section 3.2.3**.

## 2.2 Remedial Alternatives Evaluation

The RFSR (Kleinfelder, 2018b) presented evaluations of the remedial action alternatives for the former Pitch Disposal Area, the Mudflat Area and Site ground water. A summary of the remedial alternatives evaluation presented in the RFSR is included in the following subsections.

### 2.2.1 Screening of General Remedial Strategies and Technologies

The following general remedial strategies and technologies were evaluated for potential implementation to address soil and ground water impacts at IAOC A18:

- MNA;
- Excavation (using conventional construction, amphibious and dredging equipment) options including:
  - Full-scale excavation of all Pitch Material and EPH concentrations exceeding the NJDEP Category 2 EPH DPL; and
  - Limited excavation (removal of approximately 2 feet of Pitch Material, Mudflat Area soils and sediment);
- Capping systems including:
  - Impermeable cap; and
  - Reactive cap;
- Perimeter isolation/treatment including:
  - Slurry wall;
  - Sheet pile wall; and/or
  - Passive reactive barrier; and
- In-situ treatment including:
  - Solidification; and

- Stabilization.

Each of these general remedial strategies and technologies were assembled into technology process options, as indicated in **Table 1** and described in the following section.

## 2.2.2 Evaluation of Remedial Technology and Process Options

The general remedial strategies and technologies presented in the prior section were assembled into the following eleven (11) remedial technology and process options for evaluation:

- Long-term monitoring and release response;
- Excavation and off-site disposal of impacted materials using conventional construction equipment, amphibious equipment or dredging equipment;
- Reactive cap installation;
- Impermeable cap installation;
- Slurry wall installation;
- Sheet pile wall installation;
- Passive reactive barrier installation;
- In-situ solidification; and
- In-situ stabilization.

As indicated on **Table 1**, each of these remedial technology and process options were evaluated based on the following:

- Regulatory compliance (Compliance with RCRA CMS [USEPA, 2003] and the TRSR [N.J.A.C. 7:26E-5.1; NJDEP, 2018b], as well as permitting considerations) and effectiveness of remedial strategy to remove, treat or contain impacted media;
- Constructability/site access/feasibility;
- Waste transport and disposal;
- Impacts on refinery infrastructure (Pipelines including the SWL, Crude Oil Boat Lines and IRPL);
- Long-term operations and maintenance;
- The ability of the technology process option to satisfy each of the above-listed criteria; and
- The anticipated performance of the technology process option relative to the other potential technology process options.

The results of the prior evaluations of the soil and ground water remedial action alternatives presented in Sections 3 and 4 of the July 2014 FSR (TRC, 2014d) and the various pre-design investigations presented in the RFSR (Kleinfelder, 2018b) were taken into consideration when preparing the evaluation of the technology process options presented in **Table 1**.

As presented in the RFSR, none of the evaluated technology process options listed in **Table 1** can be implemented as stand-alone remedial action alternatives. However, certain technology process options (i.e., limited excavation of Pitch Material and Mudflat Area soils; impermeable cap installation; and sheet pile wall installation) can be combined to form comprehensive remedial action alternatives to address soil and ground water impacts at IAOC A18, as described in the following section.

### 2.2.3 Detailed Evaluation of Comprehensive Remedial Action Alternatives

Based on the information provided in **Sections 2.2.1** and **2.2.2**, the retained technology process options were assembled into two comprehensive remedial action alternatives to address soil and ground water impacts associated with IAOC A18.

- Alternative 1 – Limited surface excavation of Pitch Material and Mudflat Area soils, perimeter sheet pile wall installation, and reactive cap installation; and
- Alternative 2 - Perimeter sheet pile wall installation and impermeable cap installation.

A No Action alternative along with the two remedial action alternatives listed above were evaluated using the criteria listed in **Section 2.2.2**.

In addition to any remedial action implemented at IAOC A18, the BRC will be deed restricted to limit future uses of the BRC property to only non-residential uses. Therefore, a site-wide institutional control (Deed Notice) which includes IAOC A18 was filed with Union County on December 18, 2019. Also, a ground water CEA for the entire BRC site (including IAOC A18) was included with the SSWRIR (TRC, 2014c) and as required by N.J.A.C. 7:26E-8 (NJDEP, 2018b) to serve as an institutional control by providing notice that ground water does not meet the NJDEP Class II-A GWQS or site-specific Class III-B GWQC. The site-wide CEA was approved by the NJDEP on July 22, 2015. This approach is consistent with the Road Map (Kleinfelder, 2018a). Additional institutional controls such as the public notification (inform local officials and property owners, publish information in local newspapers, post signs, etc.) have been completed for the BRC and will be updated and continued as appropriate prior to and during the implementation of the selected remedial action.

#### 2.2.3.1 No Action Alternative

The "no action" alternative serves as the baseline for comparison with other alternatives. In this alternative, no action is taken so impacts remain without any treatment, control or monitoring. The Remedial Action Objectives are not achieved with this alternative, and thus this alternative is removed from consideration and no additional discussion is provided.

#### 2.2.3.2 Alternative 1 - Limited surface excavation of Pitch Material and Mudflat Area soils, perimeter sheet pile wall installation, and reactive cap installation

This alternative would include the following elements:

- Installation of a steel sheet pile wall along the Poly Ditch and around most of the perimeter of the land surface of IAOC A18;
- Limited excavation (up to approximately 2 fbg) of Pitch Material and Mudflat Area soils to accommodate installation of capping materials; and
- Installation of a reactive cap consisting of sorbent media (e.g. organo-clay or carbon) underlying imported, clean soil materials and wetland plantings.

Installation of a steel sheet pile wall around most or the entire perimeter of IAOC A18 would be performed to provide a physical barrier to isolate impacted ground water and potential LNAPL. Steel sheet pile walls are a full-scale technology that have been used for decades as hydraulic containment solutions. Due to some of the logistical concerns described below (i.e. sensitive infrastructure), this option may be paired with a hydraulic control system (i.e., a pumping well network) to ensure containment of impacted ground water. Such a system would ensure that the impacted ground water is effectively contained within the IAOC boundary so the potential to continue to impact the surrounding environment is reduced and human/ecological exposure is removed. Additional data collection and modeling to support the design of such a hydraulic control system is currently ongoing. As the focus of this technology is to isolate impacted ground water, the contaminant mass would only be reduced as the contaminants in the ground water migrate towards the hydraulic control system, which would route extracted ground water to a treatment system and/or the BRC's WWTP.

Due to the presence of the extensive existing infrastructure (IRPL, SWL, and Crude Oil Boat Lines), it will not be possible to install continuous steel sheeting around the entire perimeter of IAOC A18. As a result, gaps in the steel sheet pile wall could be addressed either by jet grouting (or similar technology) or through the use of ground water extraction wells. Concurrently with the Pilot Program investigations, modeling of IAOC A18 ground water will be performed to determine whether: (1) perimeter isolation along or south of the IRPL is required or if such sheeting can be installed along Moses Creek, with ground water managed using extraction wells to prevent flow around the ends of the sheets; and (2) ground water flow through gaps in the steel sheet pile wall beneath refinery infrastructure (i.e., IRPL, SWL, Crude Oil Boat Lines) can be managed using extraction wells or if an alternate perimeter isolation technology (e.g., jet grout or similar) is required. The results of such modeling will be incorporated into the conceptual design of the selected remedial action alternative to be provided in the forthcoming RAW.

It is currently anticipated that the perimeter steel sheeting will be installed a few feet above existing grade to limit the periodic inundation of the Mudflat Area during construction. Gaps in the steel sheet pile walls could be managed using a combination of above ground diversion structures (e.g., sand bags, earthen berms, temporary dams) supplemented with collection sumps and pumps. At the end of the remediation activities, the tops of the perimeter steel sheets may be modified or adjusted so that they are equivalent to the final surface elevation of the installed cap materials (following any associated consolidation).

Limited excavation of Pitch Material and Mudflat Area soils (up to approximately 2 fbg) would be performed for this alternative to accommodate the installation of a reactive cap. Additional Pitch Material could be removed as part of the optimization of the design for the capping system based on certain considerations including grading of the materials under the cap; potential removal of underlying materials to achieve the desired final surface elevation after cap placement (taking into consideration potential consolidation); final surface elevation/grading of cap; and thickness of capping materials. Finally, all excavated materials would be subject to offsite disposal at appropriate disposal facilities based on waste classification and waste facility permits/approvals and would be carried out in accordance with all applicable regulatory, ExxonMobil, and Phillips 66 requirements.

It is also anticipated that excavation of Pitch Material and Mudflat Area soils would require the construction of temporary stockpiles elsewhere within the BRC to perform dewatering and/or potential amendment of the excavated materials to reduce water content and make the excavated materials suitable for transportation to an appropriate offsite disposal facility. It is anticipated that any recovered liquids would be collected and routed to the onsite water treatment facility owned and operated by Phillips 66.

Capping is a non-removal remediation technique that involves leaving the impacted soil or waste in-place and placing capping components over top to prevent potential direct contact and migration of contaminants. As noted previously, Pitch Material is highly viscous and considered to be relatively immobile (**Section 2.1.1**). In addition to capping, this proposed remedy also includes an institutional control (i.e., Deed Notice) to regulate use of IAOC A18 in areas outside of the wetlands and transition zones. The wetlands and transition areas are subject to the NJDEP's land use regulations and requirements, which would be factored into the design of the capping system. Although the results of the LNAPL evaluation summarized in **Section 2.1.3** indicated limited LNAPL mobility and that previous LNAPL recovery activities described in the RFSR had effectively reduced the presence of recoverable LNAPL in the former Pitch Disposal Area, this alternative would include reactive capping materials to limit the potential for upward displacement of LNAPL during consolidation of the Pitch Material and/or Mudflat Area soils following installation of the capping components.

Finally, with regard to cap construction, the July 2014 FSR (TRC, 2014d) indicated that the site setting should be considered in the selection of the type of cap to be installed. Such a cap would ideally be consistent and supportive of the ecosystem of the site (i.e., most of IAOC A18 is designated as wetlands and transition areas). A reactive cap would mitigate the risk associated with direct contact to Pitch Material and or upward migration of contaminants, while providing an alternative that lends itself to the ecological setting. Under such an approach, a reactive cap could include the following components:

- Sorbent media layer (e.g. organo-clay, carbon, etc.);
- Alternate capping technologies (e.g. spray-applied liner or similar materials) installed beneath refinery infrastructure and/or around structural supports; and

- Clean imported surface cover materials equipped with wetland plantings.

Installation of a steel sheet pile perimeter wall (as supplemented with other isolation technologies or extraction pumping wells at gaps in the wall) would be effective in preventing contaminated ground water and LNAPL from migrating to surface water bodies, thereby reducing the risk to human health and the environment. Excavation of any impacted materials to install a surface cap would result in removal of some source material, which reduces potential contaminant migration, prevents potential human and ecological exposure to the removed material and reduces contaminant mass/toxicity which could provide limited improvement for long-term site management requirements. Installation of a reactive cap would protect human health and the environment by preventing direct contact with underlying impacted materials (i.e., Pitch Material and Mudflat Area soils), and preventing vertical migration of impacted ground water and LNAPL during consolidation of the Pitch Material and/or Mudflat Area soils following installation of the capping components. Additionally, this would provide a clean surface cover for wetland plantings to establish/re-establish wetland characteristics for this area.

For the reasons described above (i.e., preventing migration of impacted material and ground water, preventing direct contact to impacted media, and providing limited source material removal) this alternative is considered to meet the Remedial Action Objectives established for IAOC A18.

As indicated in the TRSR (N.J.A.C. 7:26E-5.1) and the Road Map (Kleinfelder, 2018), the use of green and sustainable practices during remedial action implementation is intended to improve the overall sustainability of the BRC site remediation. Such practices and technologies are, for example, less disruptive to the environment, generate less waste, increase reuse and recycling, and emit fewer pollutants including greenhouse gases to the atmosphere. The selected remedial alternative could offer environmental benefits such as: reduced waste generation and transportation to appropriate offsite disposal facilities; reduced energy consumption and use of heavy equipment; and use of native vegetation requiring little or no irrigation to restore the area as a tidally-influenced wetland. Therefore, this remedial action alternative is considered to be more sustainable than a full-scale excavation alternative due to the short-term impacts associated with excavating all impacted materials and the extensive material dewatering, handling, and transportation requirements associated with removing the impacted materials for transportation to an off-site disposal facility.

#### 2.2.3.3 Alternative 2 - Perimeter sheet pile wall installation and impermeable cap installation

This alternative would include the same elements as Alternative 1 (**Section 2.2.3.2**) with the following two exceptions:

- Limited excavation of Pitch Material and/or Mudflat Area soils would only be performed as necessary based on the design for the construction of the cap (i.e., to account for

potential grading, drainage, and/or flood storage considerations) and/or as needed to lower the existing surface grade where Pitch Material or Mudflat Area soils are contacting the SWL; and

- The reactive cap contemplated in Alternative 1 would be replaced by an impermeable cap (featuring different materials of construction) that is essentially installed on top of the existing Pitch Material and Mudflat Area soils, with the underlying materials allowed to consolidate under the weight of the constructed cap materials.

Both Alternative 1 and Alternative 2 would have similar logistical considerations, with the following exceptions. First, given the elimination or reduction in the quantity of material excavation associated with this alternative, the need for and/or size of a temporary stockpile and dewatering area would be evaluated based upon the actual volume of Pitch Material and/or Mudflat Area soils subject to excavation identified during the design of the remedial alternative. Second, the impermeable cap would include slightly different cap components than a reactive cap. Such an impermeable cap could include the following components:

- Cushion geotextile fabric layer;
- Impermeable geosynthetics layer (e.g., linear, low-density polyethylene liner);
- Drainage composite layer;
- High permeability collection features for potentially mobile Pitch Material, LNAPL, and/or off-gas;
- Alternate capping technologies (e.g. spray-applied membrane liner, or similar materials) installed beneath sensitive infrastructure and/or around structural supports; and
- Vegetative cover equipped with wetland plantings.

The benefits for Alternative 2 are nearly identical to Alternative 1 (see **Section 2.2.3.2**), with the exception that Alternative 2 would require less source material removal for cap installation.

The limitations/challenges for Alternative 2 are essentially the same as Alternative 1 (see **Section 2.2.3.2**). However, certain limitations/challenges associated with the excavation of impacted materials (e.g., material staging/dewatering requirements, temporary material stockpiles, volume of water treatment) could see a corresponding reduction, as impacted material excavation activities are reduced or eliminated. In addition, any increase in the final surface elevation of the Mudflat Area associated with the installation of capping materials on top of existing grade to restore the area as a tidally-influenced wetland will need to account for potential impacts to the floodway for Moses Creek and the Poly Ditch (i.e. could require a hardship exemption). An evaluation of the feasibility of restoring the area as a tidally-influenced wetland is ongoing and the results will be incorporated into the remedial design and presented in the forthcoming RAW.

## 2.3 Proposed Remedial Alternative for IAOC A18

Of the two remedial alternatives presented in **Section 2.2.3**, Alternative 2 (perimeter sheet pile wall installation and impermeable cap installation) is the proposed remedial alternative for IAOC A18. Conceptual drawings of the selected remedial alternative, which were presented in the RFSR, are provided as **Figures 6 and 7**. A hydraulic control system is an element of the proposed remedial action. This system is intended to prevent mounding of groundwater upgradient of the hydraulic barrier wall and prevent migration of LNAPL and dissolved contaminants in groundwater to the surface water bodies through gaps in the barrier wall at utility crossings. Capping and containment of contaminants are proven remediation technologies that are consistent with the RCRA CMS (USEPA, 2003), the TRSR (N.J.A.C. 7:26E-5.1; NJDEP, 2018b) and the NJDEP-approved Road Map (Kleinfelder, 2018a). This alternative offers the following advantages over other alternatives evaluated for IAOC A18:

- This alternative poses less impact to the refinery operations than an alternative involving limited surface excavation, as such an alternative would generate more waste, and therefore would require more space for waste handling and more traffic within the refinery to transport such materials.
- There is less risk of damage to critical refinery infrastructure. The amount of material to be removed is limited to the amount required for the capping system installation. Decreasing the amount of material removed near the SWL, Crude Oil Boat Lines and IRPL decreases the risk of failure from deflection of the supporting timber piles.
- Because of the buffer zones that would be required for excavating around refinery infrastructure, some amount of impacted material (Pitch Material and Mudflat Area soils) would need to remain in-place. A capping alternative (i.e. alternative capping technology) can be implemented adjacent to and beneath the refinery infrastructure to prevent exposure of human and ecological receptors to contaminated materials.
- Because this alternative requires only minimal material removal, worker exposure to contaminants through inhalation or direct contact is minimal compared to the alternative that involves limited surface excavation.
- An impermeable cap was selected over the reactive cap for the following reasons:
  - An impermeable cap can be installed over existing grade with limited excavation. A reactive cap would require more material to be removed, and thus generate more waste.
  - An impermeable cap would require less water management than a reactive cap due to limited infiltration from precipitation or from surface water inundation of the Mudflat Area.
  - An impermeable cap would help limit migration of impacted ground water (along with perimeter containment and hydraulic control system).
  - An impermeable cap would have no ongoing operation and maintenance (O&M) of reactive media. O&M of a reactive cap could be challenging and costly. Additionally, mobilization of LNAPL during cap consolidation could rapidly exhaust the reactive media.



Vegetation has been proposed as a means of stabilizing the impermeable cap. A pilot study was conducted to evaluate whether wetland vegetation can be established in cover soils placed over the impermeable cap. The results of the pilot study indicate that establishment of wetland vegetative growth to stabilize the impermeable cap is contingent upon raising the ground surface elevation. A key design parameter of sustainable vegetative growth is elevation and a key component of the pilot study was to establish the optimal elevation for wetland vegetative growth. The specific elevation range at which wetland plantings thrive is currently being evaluated and will be incorporated into a RAW and final design. The NJDEP DLUR indicated during an onsite permit pre-application meeting on January 24, 2018 that a net fill of the Mudflat Area with a hardship exception could be considered. Floodway modeling of the Poly Ditch and Morses Creek is also ongoing to understand the flood impacts related to the placement of fill material within the Mudflat Area. Enhancement of the existing Mudflat Area as a vegetated salt marsh and applying the wetland restoration credits to another remediation project at the BRC was considered, but determined to be a less desirable approach because this would require a deed restriction specifically for IAOC A18.

Each element of the proposed remedial action will be monitored for effectiveness at meeting the remedial objectives of isolating Pitch Material, LNAPL, adsorbed-phase contaminants and dissolved-phase contaminants from receptors. In addition to these remedial actions proposed in the RFSR (Kleinfelder, 2018b), institutional controls including a deed notice and CEA will be implemented for IAOC A18.

The Pilot Program investigations include the testing of a variety of capping configurations installed at various elevations (i.e., with and without material excavation) to evaluate performance of the various cap materials, consolidation of the underlying materials, and the survivability of various potential wetland plantings. The results of these investigations will be provided in the forthcoming *Pilot Study Summary Report* and will be incorporated into the conceptual design of the selected remedial action alternative to be provided in the RAW.

### 3 TECHNICAL IMPRACTICABILITY EVALUATION

---

This section details the applicability of NJDEP regulations and guidance as well as technical impracticability considerations for removal or treatment remedial action alternatives for IAOC A18.

#### 3.1 Applicability of NJDEP Regulations and Guidance

This section provides an overview of regulations and guidance that are applicable to a technical impracticability determination and the associated justification or rationale for how that regulation or guidance applies to IAOC A18. Further, a description of previous interactions and direction from the NJDEP is provided to support the technical impracticability determination. The regulations and guidance and associated site-specific applicability presented in this section includes:

- NJDEP's April 30, 2019 letter regarding the RFSR;
- NJDEP's *Evaluation of Extractable Petroleum Hydrocarbons in Soil Technical Guidance* (NJDEP, 2019); and
- *USEPA Office of Solid Waste and Emergency Response Directive 9234.2-25* as referenced in the NJDEP's *Technical Impracticability Guidance for Groundwater* (NJDEP, 2013c).

##### 3.1.1 NJDEP's April 30, 2019 RFSR Comment Letter

The letter states the following:

*The Department specifies that 30,000 mg/kg is the ceiling concentration for capping activities for soil (maximum ceiling number in the EPH calculator, when using the grain size). The elevated levels above 30,000 mg/kg EPH shall be removed to comply with N.J.A.C. 7:26E-5.1(e). The removal of high concentration of free product was not evaluated in the report. If it is not practicable, a technical impracticability report shall be submitted as indicated in the Protocol for Addressing Extractable Petroleum Hydrocarbon guidance document.*

#### Site-specific Applicability

EPH concentrations in soil have exceeded the NJDEP's ceiling concentration of 30,000 mg/kg at the locations shown on **Figure 5** within the Former Pitch Disposal Area, Mudflat Area and the area east of the Poly Ditch in IAOC A18. Pitch Material in IAOC A18, which is considered to be free product, is primarily located in the former Pitch Disposal Area at the northwestern portion of the IAOC, but has also been observed as sporadic non-contiguous deposits,

occasionally at the surface, within the Mudflat Area. Exceedances of the NJDEP EPH Category 2 DPL have been detected at depths ranging from the ground surface to approximately 12 fbg.

### 3.1.2 NJDEP's Evaluation of Extractable Petroleum Hydrocarbons in Soil Technical Guidance

Section 4.2.2 of the NJDEP's EPH Guidance states the following:

*The Department recognizes that compliance with the EPH product limit may be impracticable for meeting the requirement at N.J.A.C. 7:26E-5.1(e) to treat or remove free product and residual product at large or complex non-residential sites. For purposes of this technical guidance, large sites would consist of refineries and petroleum storage facilities that extend over multiple acres with multiple AOCs. An example of a complex site is a MGP site. Typically, these large and complex sites also involve:*

- Impacts to ground water or surface water;*
- a potential for vapor intrusion or ecological risk;*
- off-site migration of EPH product; or*
- an active facility with continuing operations.*

#### Site-specific Applicability

The BRC is a large, active refinery and petroleum storage facility consistent with the description included in the NJDEP's EPH Guidance. The BRC is approximately 1,300 acres, while IAOC A18 is approximately 16 acres. Impacts to ground water and surface water have been documented at the BRC, including in and around IAOC A18. While vapor intrusion is not a concern for IAOC A18, vapors and nuisance odors are generated when removing Pitch Material and impacted soils. Additionally, ecological risk is a concern. IAOC A18 is located adjacent to a surface water body and much of this area is mapped as a wetland. Offsite migration of LNAPL is not generally a concern for IAOC A18 as LNAPL has been demonstrated to be functionally immobile in the subsurface (Kleinfelder, 2018b), further supporting a capping and containment approach for this IAOC. Similar capping and containment remedial actions to those proposed for IAOC A18 (**Section 2.3**) have been implemented for LNAPL and EPH concentrations exceeding 30,000 mg/kg at other IAOCs at the BRC, consistent with the NJDEP-approved Road Map (Kleinfelder, 2018a) because these remedial actions are protective of public health, safety and the environment.

The NJDEP's EPH Guidance also states the following:

*For these types of sites, the investigator is advised to seek consultation with the Department before proceeding with a determination of impracticability or making a final decision on a remedial action. The typical variation for these types of sites may involve long-term remedial actions that may delay full compliance with the requirement to treat or remove free*

*product and residual product, or it may involve remedial actions that include some form of containment and active remedial actions for soil and other media. All variances from the Technical Rules shall be documented in the applicable remedial phase report pursuant to N.J.A.C. 7:26E-1.7. All deviations from this technical guidance shall be documented in the applicable remedial phase report pursuant to N.J.A.C. 7:26E-1.5(b) and Administrative Requirements for the Remediation of Contaminated Sites (ARRCS) Rules pursuant to N.J.A.C. 7:26C1.2(a)3.*

#### Site-specific Applicability

On July 25, 2017, a meeting between representatives of ExxonMobil, Phillips 66, the LSRP, Arcadis, Kleinfelder and the NJDEP was held to review the results of the PDI activities conducted between 2015 and 2017. During that meeting, technical challenges of implementing investigation and construction activities in IAOC A18 were discussed. The remedial strategy of containment via a hydraulic barrier wall and capping system and a hydraulic control system was also discussed as the strategy that would be proposed in the forthcoming RFSR. On January 24, 2018, a meeting between representatives of the NJDEP DLUR and Flood Hazard Group, ExxonMobil, Phillips 66, Arcadis, Kleinfelder and the LSRP was held onsite at IAOC A18 to review permitting requirements and potential permitting issues associated with upcoming Pilot Program activities. During this meeting, the NJDEP DLUR indicated that a net fill of the Mudflat Area, as proposed in the RFSR, with a hardship exception could be considered.

In March 2018, the Road Map (Kleinfelder, 2018a) was submitted to the NJDEP. The Road Map stated that ExxonMobil plans to utilize containment remedies in order to streamline the remedial investigation and/or remedial alternative selection process due to the nature of the BRC as an active refinery. The Road Map was approved by the NJDEP on December 10, 2018 (NJDEP, 2018c).

On June 18, 2019, a meeting between representatives of ExxonMobil, Phillips 66, the LSRP, Arcadis, Kleinfelder and the NJDEP SRP and BEERA was held to review the NJDEP's comments on the RFSR. During that meeting, the conceptual site model, site conditions and technical impracticability considerations were also discussed. A written summary of the topics discussed during the meeting and in follow-up telephone conversations between the NJDEP SRP Case Manager and the LSRP was submitted to the NJDEP on July 25, 2019 (**Appendix A**). The NJDEP Case Manager responded to the July 25, 2019 submittal saying that the data presented to the NJDEP in the RFSR and the June 18, 2019 meeting demonstrated the technical challenges. However, a *TI Report* and *Pilot Study Summary Report* are supporting documents to the RFSR which are necessary to demonstrate the technical challenges of IAOC A18. This *TI Report* has been prepared to document the technical impracticability considerations associated with implementing removal or treatment remedial actions in IAOC A18. A *Pilot Study Summary Report* will be submitted to the NJDEP under separate cover to document the activities conducted during the Pilot Program. A *RFSR Addendum* will be

submitted to address NJDEP's comments # 3, 4, 7 and 9 from the April 30, 2019 letter which were not addressed in the August 15, 2019 response to comments.

Section 4.2.2 of the NJDEP's EPH Guidance states:

*There are circumstances where it may be technically impracticable to completely remediate free product and residual product to the applicable EPH product limit in soil. Common impediments are physical obstacles that inhibit or preclude accessibility to the product. It is contingent upon the investigator to evaluate both removal and treatment options before acceding it is technically impracticable to remediate free product and residual product, and to include a description of the evaluations used to conclude technical impracticability in the applicable remedial phase report.*

#### Site-specific Applicability

Removal and treatment options were considered, and the evaluation of these remedial alternatives was presented in both the FSR (TRC, 2014d) the RFSR (Kleinfelder, 2018b). This report formally documents the technical impracticability considerations associated with removal or treatment of Pitch Material, soil exceeding the 30,000 mg/kg EPH product "ceiling limit", and LNAPL from IAOC A18. Further, the information provided supports the proposed containment remedial action which includes a barrier wall, an impermeable capping system, and a groundwater recovery system to maintain hydraulic control. The technical impracticability considerations are detailed in **Section 3.2**.

#### 3.1.3 *USEPA Office of Solid Waste and Emergency Response Directive 9234.2-25*

As referenced in the NJDEP's *Technical Impracticability Guidance for Ground Water* (NJDEP, 2013c), the 1993 USEPA guidance document, *USEPA Office of Solid Waste and Emergency Response Directive 9234.2-25*, provides the following summary of factors to be considered in making a TI determination:

*...a TI determination involves a consideration of engineering feasibility and reliability in attaining media cleanup standards, as well as situations where remediation may be technically possible, but the scale of the operations required may be of such magnitude and complexity that the remedial alternative would be impracticable.*

#### Site-specific Applicability

Results of the Pilot Program conducted in 2018 and 2019 indicate that remedial activities such as access road construction, steel sheet pile wall construction, impermeable cap construction and limited excavation can be conducted in IAOC A18. However, access for the removal or treatment of free and residual product, including Pitch Material, and soil with EPH

concentrations the 30,000 mg/kg “ceiling limit” in IAOC A18 is restricted by active refinery infrastructure, physical characteristics of the surface and subsurface, and surface water. Because of these restrictions, the magnitude and complexity of removal or treatment would make implementation of such remedial alternatives technically impracticable. The technical impracticability considerations evaluated for the removal and treatment remedial alternatives are presented in **Section 3.2**.

The proposed containment remedial action which includes a subsurface barrier wall, an impermeable capping system, and a groundwater recovery system to maintain hydraulic control are protective of public health, safety and the environment and are consistent with the NJDEP-approved Road Map (Kleinfelder, 2018a).

### 3.2 Technical Impracticability Considerations

The following subsections detail key site-specific factors to support the technical impracticability of implementing removal or treatment remedial actions for IAOC A18. Factors evaluated include limitations imposed by third party ownership; access limitations imposed by active refinery infrastructure; physical characteristics of surface and subsurface materials; surface water; and air emissions. The removal and treatment remedial action scenarios developed to evaluate the technical impracticability are as follows:

- Removal Remedial Action Scenario – A removal remedial action scenario would consist of full-scale excavation of Pitch Material and impacted soil to the extent delineated and replacement with clean material. For the purposes of this technical impracticability evaluation, removal would consist of excavation to the delineated extent of the detected EPH concentrations in soil that exceed the EPH product “ceiling limit” to a depth of approximately 12 fbg for the IAOC A18 area.

To facilitate excavation to this depth, an excavation support system would be needed to retain the adjacent Moses Creek surface water and sediments and protect refinery infrastructure in the area. Considering the active refinery infrastructure (SWL, IRPL, and Crude Oil Boat Lines) and safe offsets required to protect the integrity of the infrastructure, Pitch Material and impacted soils within the safe offsets of the infrastructure cannot be removed and therefore need to remain in place. The physical characteristics of the surface and subsurface limit the size of equipment able to access the work area and increase the complexity of implementation of the project due to extensive subsurface improvement that would be needed to facilitate access. Additionally, dewatering of the excavation would be required and the surface water variability resulting from tidal influence would increase the complexity of construction and create potential loss-of-life worker safety hazards. Further, excavation and exposure of the Pitch Material and impacted soil across IAOC A18 would generate air emissions and nuisance odor concerns potentially threatening worker safety and the public due to the proximity of the work area to the New Jersey Turnpike.

Under a removal remedial action scenario, the magnitude of materials management and duration of construction would be extensive. The estimated total volume of Pitch Material and impacted soil to be excavated would be approximately 287,500 cubic yards. In general, a standard dump truck can transport approximately 12 cubic yards of soil (+/- depending on the bulk density of the material transported). Based on these estimates, approximately 23,960 truckloads of material would be transported offsite for disposal after dewatering. Amendment of excavated soil with a stabilizing material (i.e. cement kiln dust, lime kiln dust or Portland cement) would likely be necessary prior to transportation, which would result in an increased volume of waste to be disposed, and an increased number of truckloads needed. In general, a standard dump truck can transport approximately 8 cubic yards of certified clean stone. Based on the volume of material to be excavated, approximately 35,940 truckloads of certified clean backfill material would need to be imported to the site. Vehicles transporting waste for offsite disposal and clean backfill from and to IAOC A18 would have an adverse impact on the site and surrounding areas through greenhouse gas emissions, increased traffic, localized noise, vibration and wear and tear on roadways.

- Treatment Remedial Action Scenario - A treatment remedial action scenario would consist In-situ Soil Stabilization (ISS) to immobilize the contaminants. ISS bench-scale studies were performed by TRC and Kleinfelder and the results were presented in the FSR (TRC, 2014d) and RFSR (Kleinfelder, 2018b), respectively. The results of both ISS bench scale studies indicated that this was not a viable remedial alternative because the volume of the treated soil approximately doubled when amended with the selected ISS reagents. This increase in volume could impose lateral forces on the supports of the SWL, Crude Oil Boat Lines and IRPL in the subsurface which could lead to displacement of the supports and failure of the refinery infrastructure. The impacted subsurface materials beneath and within the safe offsets of the refinery infrastructure would not be accessible to the equipment that would be needed to implement an ISS remedy. In addition to the risks to active refinery infrastructure, ISS is not a viable remedial alternative for IAOC A18 because Pitch Material and LNAPL are not compatible with ISS reagents that are used to stabilize or solidify soil and the results of the bench-scale studies indicate that certain contaminants may still be leachable after treatment. Furthermore, LNAPL could be mobilized in the subsurface by implementing ISS and leaching of contaminants from treated soil could result in ongoing impacts to groundwater. The peat layer beneath IAOC A18 is a potential “sink” for ISS reagents applied. Because the peat layer extends beneath the majority of IAOC A18, ISS reagents applied may be transported through this highly permeable layer to other areas of the IAOC, or potentially to the adjacent water bodies. Additionally, ISS reagents do not effectively treat soils with a high organic content, such as the peat layer beneath IAOC A18, unless they are added in quantities that result in significant volume increases, as was observed in the two bench scale studies described above.

### 3.2.1 Third-Party Ownership and Active Refinery Infrastructure

The BRC is an active facility that is owned and operated by Phillips 66. Remedial actions proposed for IAOCs within the BRC must be approved by Phillips 66. Every effort needs to be made to minimize disruption to refinery operations during investigation and remediation activities.

Many areas of the BRC contain large, complex industrial infrastructure, both above-ground and below-ground, which store and convey hazardous materials including flammable and/or explosive materials. As such, these areas are currently rendered inaccessible for intrusive work. Other infrastructure throughout the BRC which store or convey less hazardous or non-hazardous materials may also be critical to refinery operations, and the areas in and around this infrastructure may also be restricted or inaccessible for intrusive work. Details of critical refinery infrastructure in and around IAOC A18 that limit access and restrict activity are included below.

The BRC normally operates 24 hours a day, 7 days a week, with infrequent periods of operational shutdown during scheduled “turnaround” periods where large-scale refinery maintenance activities are conducted. Performing removal or treatment of Pitch Material and impacted soil during a turnaround period to minimize the risk to active refinery infrastructure has been considered. However, the scale of these remedial alternatives would be extensive, and could not be completed in the “turnaround” periods. Additionally, although inactive during the “turnaround” periods, the risk of damage to critical refinery infrastructure would not be reduced and damage may not be detected until the infrastructure is put back into service after the turnaround, thus disrupting refinery operations and resulting in a release to the environment and potential loss-of-life worker safety risk.

Below are descriptions and photographs of the critical refinery infrastructure that detail the challenges and limitations that each poses, which contributes to the determination that a removal or treatment remedial option is technically impracticable. The locations and orientations of the photographs included below are shown on **Figure 8**. The accessibility limitations described below are detailed on **Figure 9**.



## Salt Water Line (SWL) – Access and Activity Restrictions



Exhibit 1 – View of the SWL from the scaffold, facing east.

The SWL is located in the northern portion of IAOC A18 and extends from east to west through the Former Pitch Disposal Area, the Mudflat Area and the area of IAOC A18 east of the Poly Ditch. A detailed description of the SWL is included in **Section 1.2.3**. Personnel can access the Mudflat Area south of the SWL via a scaffold that crosses over the line. Motorized equipment cannot access the Mudflat Area to the south of the SWL from the north. During Pilot Program activities conducted in 2019, lightweight motorized equipment accessed the Mudflat Area south of the SWL via a barge in Morses Creek, but experienced difficulty performing pilot scale activities such as excavation of test pits due to the physical characteristics of the surface and subsurface materials, which are detailed in **Section 3.2.2**. In the easternmost area of IAOC A18 located to the east of the Poly Ditch, personnel can access the area to the north of the SWL via elevated walkways constructed over the IRPL at the northern boundary of IAOC A18. Personnel must access the area to the east of the Poly Ditch south of the SWL via a boat launched from the eastern side of Morses Creek adjacent to the New Jersey Turnpike. Motorized equipment has not been able to access the area east of the Poly Ditch to date.

## Crude Oil Boat Lines – Access and Activity Restrictions



Exhibit 2 – View of the Crude Oil Boat Lines facing northeast. The white pipelines elevated on wooden pilings are the in-service pipelines. The pipelines on the Mudflat Area surface are the out-of-service Crude Oil Boat Lines.

The Crude Oil Boat Lines extend northeast to southwest across the Mudflat Area and the area to the east of the Poly Ditch. A detailed description of the Crude Oil Boat Lines is included in **Section 1.2.3**. Personnel can access the Mudflat Area to the southeast of the Crude Oil Boat Lines by crossing the scaffold over the SWL and walking under the Crude Oil Boat Lines. Motorized equipment cannot access the area to the southeast of the Crude Oil Boat Lines from the northeast. During Pilot Program activities, lightweight motorized equipment accessed the area to the southeast of the Crude Oil Boat Lines via a barge in Morses Creek. Access to the area of IAOC A18 to the east of the Poly Ditch is described above.



## Inter-refinery Pipelines (IRPL) – Access and Activity Restrictions



Exhibit 3 – View of the IRPL at the northwestern portion of IAOC A18, facing east. The area beyond the pipelines is part of IAOC A18 and is considered to be part of the former Pitch Disposal Area.

The IRPL are located on metal pipe racks extending northwest to southeast at the northern boundary of IAOC A18, adjacent to the butane/propane caverns area (IAOC A17). A detailed description of the IRPL is included in **Section 1.2.3**. Access to the rectangular area formed by the various pipelines is restricted by the pipelines. Personnel can access this area via elevated walkways from the butane/propane caverns area (IAOC A17) to the north, but motorized equipment cannot access this area which would make removal or treatment of Pitch Material and impacted soil technically impracticable.

### SWL, Crude Oil Boat Lines and IRPL – TI Considerations

In addition to the access challenges presented by the SWL Crude Oil Boat Lines and IRPL, ground-intrusive work in the vicinity of these pipelines is limited by several factors.

- Based on slope stability modeling performed by Kleinfelder and presented in the RFSR, an unsupported 8-foot or greater depth excavation near the SWL is not feasible due to potential slope instability. The wooden piles are sensitive to lateral displacements, and displacements as small as 1 inch may result in overstressing of the piles, which could lead to failure of the SWL. Slope stability modeling has not been performed for areas near the Crude Oil Boat Lines or IRPL to date, but it is expected that results would be similar for the Crude Oil Boat Lines because these pipelines are supported on timber piles similar to the SWL, and subsurface lithology in the area of

the SWL is similar to what has been observed in the area of the Crude Oil Boat Lines. Removal of Pitch Material and impacted soil adjacent to the SWL is technically impracticable due to the risk of displacement of the timber piles and failure of the critical refinery infrastructure. Removal of impacted soil adjacent to the Crude Oil Boat Lines is technically impracticable because there is a similar risk of displacement of the timber piles and failure of the pipelines. Pitch Material and impacted soil would remain in place beneath and adjacent to the SWL and Crude Oil Boat Lines due to the risk of failure of these pipelines.

- Construction activities such as sheet pile installation or operation of construction equipment near refinery infrastructure can generate vibration which can potentially affect the timber piles. Vibration monitoring has been conducted via seismographs installed along the alignment of the SWL throughout Pilot Program activities. Thresholds specified in the SWL Monitoring Plan for the Pilot Program, which were approved by P66 prior to the start of this work, have not been exceeded during pilot-scale construction activities. Vibration monitoring will be required for future construction activities near the SWL, Crude Oil Boat Lines and IRPL. Vibrations in excess of the thresholds may require work to be stopped to prevent failure of the refinery infrastructure.
- The SWL, Crude Oil Boat Lines and IRPL are critical refinery infrastructure and operations. A breach in these would not only result in a disruption to refinery operations or a release to the environment but could also result in loss of life for workers in this area. Protecting the safety of the workers by avoiding potential failure of the refinery infrastructure is a top priority.
- Pitch Material and impacted soil that is inaccessible beneath or adjacent to the active refinery infrastructure would remain in place.

## Caverns Area (IAOC A17) Proximity – TI Considerations

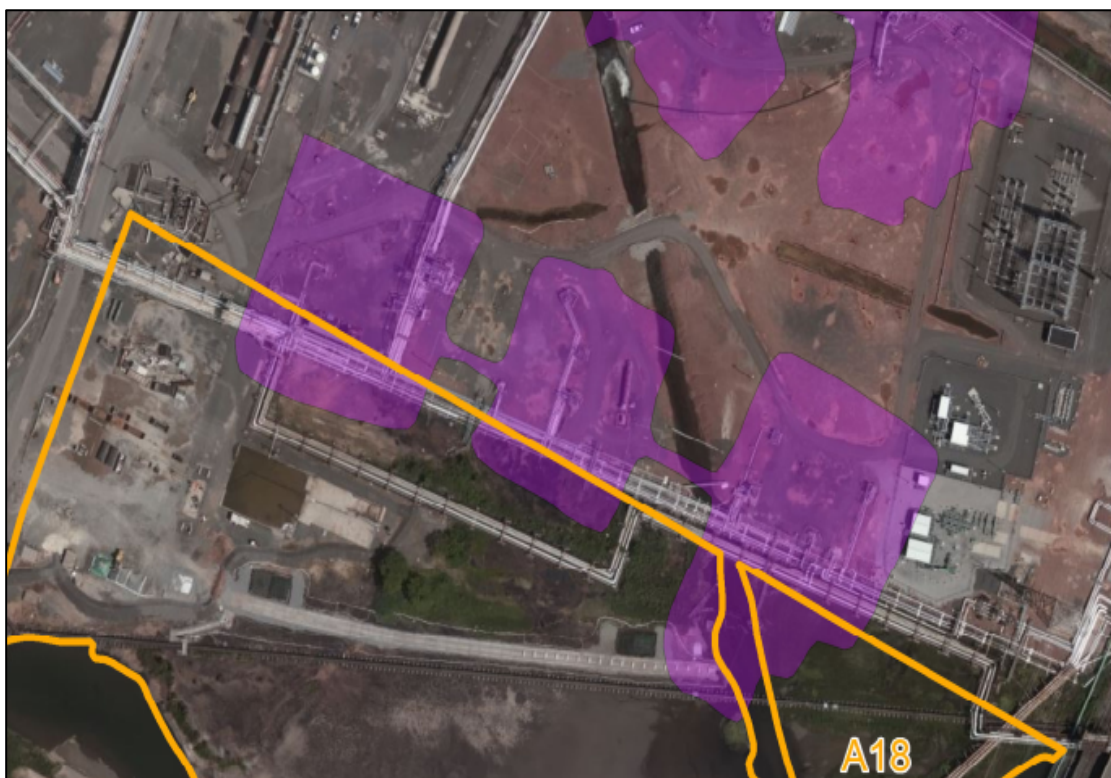


Exhibit 4 – An aerial photograph of the northern portion of IAOC A18. The locations of the propane/butane caverns are shown in purple.

The Caverns Area (IAOC A17) is located adjacent to IAOC A18 to the north and northeast. The caverns were constructed approximately 300 fbg within the bedrock underlying what is now IAOC A17 in 1958. The caverns extend horizontally from the area of the former ERB in IAOC A18 to the railroad spurs adjacent to the Cogeneration Area (IAOC A16). Unknown volumes of butane and propane are stored under pressure in the caverns. Alarms are activated at the Caverns Area due to the release, or suspected release, of an unknown volume of butane and/or propane. The expectation from Phillips 66 when an alarm is activated in the Caverns area is that:

- Work is to be stopped and personnel are to evacuate from the vicinity of the Caverns immediately; and
- All motorized equipment is to be stopped and evacuations are to be done on foot because of the risk of an explosion that could be ignited by the engines or other mechanical components of motorized equipment.

Because IAOC A18 is adjacent to IAOC A17, work in IAOC 18 must stop and personnel must evacuate the area on foot when an alarm is activated at the Caverns Area. With the limited means of access to and egress from the Mudflat Area south of the SWL, the time required to evacuate on foot from this area could be considerable and would present an additional risk to worker safety. The evacuation routes from the area east of the Poly Ditch in IAOC A18 include a route through IAOC A17 which could not be utilized in the event of an alarm at the Caverns

Area, and a route across Morses Creek via a boat or barge which would present considerable risks to worker safety.

In addition to the potential evacuation safety risk, if full-scale removal of Pitch Material and impacted soil were to be conducted in any part of IAOC A18, the release of butane and/or propane could cause a loss-of-life worker safety risk because:

- Materials would be excavated to a depth of approximately 12 fbg within a shored excavation;
- It would take additional time for the operator to evacuate from the shored excavation; and
- Butane and propane are denser than air and would settle within the shored excavation which would present an asphyxiation hazard in addition to an explosion hazard.

### Summary of Active Refinery Infrastructure – TI Considerations

Active refinery infrastructure located within IAOC A18 limits or eliminates access for the removal or treatment of Pitch Material and impacted soils and presents loss-of-life worker safety risk for remedial action implementation. Additionally, due to the proximity of the work area to the Caverns area, there is the potential for frequent alarm conditions requiring evacuation and the potential for a propane or butane hydrocarbon release that presents a loss-of-life worker safety risk. Therefore, the need to protect active refinery infrastructure and worker safety supports that removal or treatment remedial action alternatives are technically impracticable.

#### 3.2.2 Physical Characteristics of Surface and Subsurface Materials

The physical characteristics of the surface and subsurface materials within IAOC A18 increases the magnitude and complexity of remedial action implementation due to access restrictions and limitations on the size of equipment that can perform work in the area without extensive subsurface improvements, supporting the determination that removal or treatment remedial action alternatives are technically impracticable.





Exhibit 5 – An excavator encountered soft and compressible soil conditions and became stuck in IAOC E3 (Central Landfill) located to the southwest of IAOC A18, across Morses Creek. The soft and compressible conditions encountered in IAOC E3 were similar to what has been observed in IAOC A18.

The surficial materials consist of Pitch Material and Mudflat Area soils. Pitch Material is a relatively soft asphalt-like material that becomes softer during the warmer months of the year that is not compressible but displaces outward when a load is applied to the surface. Mudflat Area soils consist primarily of dredge spoils with sporadic, non-contiguous Pitch Material deposits that are soft and cannot support larger motorized equipment without structural improvements. The former Pitch Disposal Area and Mudflat Area are underlain by a meadow mat layer which is highly compressible and unable to support most motorized equipment such as drill rigs or excavators. The Pilot Program collected data on the physical characteristics of surface and subsurface materials and the findings demonstrate that the conditions increase the magnitude and complexity of a removal or treatment remedial action supporting technical impracticability.

#### Summary of Pilot Study Results and Observations

The physical characteristics of the surface and subsurface materials limit access to both the former Pitch Disposal Area and the Mudflat Area. During historical RI activities, the former Pitch Disposal Area north of the SWL was accessed by a small direct-push drill rig (Geoprobe 6610DT, or similar model; approximately 6,000 pounds) with the use of swamp mats to advance soil borings and install monitoring wells. Direct-push drill rigs were not capable of accessing the Mudflat Area north of the SWL, any area south of the SWL or the area east of the Poly Ditch during historical RI activities. Issues encountered by equipment used to

perform investigation and pilot study activities during the Pilot Program demonstrate that access to the Mudflat Area south of the SWL and the area east of the Poly Ditch is technically impracticable to implement a removal or treatment alternative. The Pilot Study results and observations are summarized below and will be presented in greater detail in the *Pilot Study Summary Report*.



Exhibit 6 – Equipment access and operations in the Mudflat Area was evaluated during the Pilot Program in 2019.

Based on the Pilot Program, the largest equipment that can be supported on the Mudflat Area with multiple layers of swamp mats is approximately 6,500 pounds, and this can only be achieved for a limited amount of time. A walk-behind loader (Dingo TX1000; approximately 2,700 pounds) and small excavator (Bobcat E26; approximately 6,500 pounds) accessed the Mudflat Area south of the SWL via a barge in Morses Creek to evaluate equipment maneuverability in the Mudflat Area, to excavate test pits and to transport fill material from the barge to the wetland vegetation pilot study test cells. These activities occurred during a period of the lunar cycle when the Mudflat surface was not inundated with surface water. Neither machine was able to maneuver on the Mudflat surface without additional structural support elements (plywood and swamp mats). When plywood and swamp mats were used to support the walk behind loader and small excavator, these machines could only remain stationary in the Mudflat Area for a limited amount of time (less than 5 minutes) before they started sinking due to compression of the subsurface materials. A typical excavator that would be used for a removal remedial action to a depth of 12 fbg would be a CAT15 Excavator with a weight of approximately 36,000 pounds. In order for construction and remediation equipment of this type to access the former Pitch Disposal Area and Mudflat Area for a prolonged period of time, a more robust structural support system similar to the access road described below would be



needed. The access road would need to be constructed at multiple locations across IAOC A18 to implement a removal remedial action due to the limited reach of the excavator.

A temporary access road was constructed across the former Pitch Disposal Area and Mudflat Area north of the SWL during the period of October 24, 2018 through December 18, 2018. The temporary access road was constructed to facilitate access for construction and remediation equipment such as drill rigs, excavators, front-end loaders and concrete trucks, and to determine the minimum construction specifications for access road construction during full-scale remedy implementation. The temporary access road was constructed of the following (from the bottom upward):

- A woven geotextile fabric;
- Approximately 6 inches of 2.5-inch crushed stone;
- A non-woven geogrid layer;
- Approximately 6 to 12 inches of 2.5-inch crushed stone;
- Two to three layers of wooden swamp mats anchored with 6-foot long duckbill anchors.



Exhibit 7 – The temporary access road under construction in the former Pitch Disposal Area on the north side of the SWL during the Pilot Program.

Approximately 1,150 tons of 2.5-inch crushed stone were used to complete the temporary access roadway which measured approximately 600 feet long x 15 feet wide. The wooden swamp mats are approximately 10 feet wide by 12 feet long and constructed of three layers of 2-inch by 6-inch boards arranged in alternating directions. Settlement of the temporary access roadway was monitored during construction and continues to be measured during bi-

weekly surveys. Certain sections of the roadway were supplemented with additional 2.5-inch crushed stone after approximately five months due to settlement. To date, settlement of the roadway is within the expected range based on modeling conducted during the PDI. Outward displacement of Pitch Material has also been observed at the ground surface along the sides of the roadway.



Exhibit 8 – Outward displacement of Pitch Material from the temporary access road.

Limited excavation was conducted north of the SWL in the former Pitch Disposal Area and Mudflat Area using a CAT 15 excavator (approximately 36,000 pounds) positioned on the temporary access roadway during the Pilot Program. Excavation was conducted in test cells supported by steel sheet piles and in unsupported areas adjacent to the temporary access roadway. The excavations within the steel sheet piles were completed to approximately 3 fbg for the installation of the impermeable cap test cell components. The unsupported excavations were completed to approximately 4 to 5 fbg. Based on the results of the equipment operations on the temporary access roadway during the Pilot Program, excavating equipment up to approximately 36,000 pounds can be supported on a roadway constructed as described above.

It is expected that access road construction would be less extensive for a capping/containment remedy than for a removal or treatment remedy, especially if steel sheet piles can be installed from a barge in Morses Creek rather than on the surface of the Mudflat Area. In order to implement a removal or treatment remedy, access roads would need to be removed and relocated to access the Pitch Material and impacted soil beneath, thus increasing the magnitude and complexity of a removal or treatment remedy.

Another factor that increases the complexity of remedial action implementation is potential mobilization of LNAPL resulting from compression of subsurface materials during construction activities. As detailed in **Section 2.1.4**, LNAPL was detected in monitoring well GMW-749 in the Mudflat Area north of the SWL during Pilot Program activities. Residual LNAPL may have already been present in the area of GMW-749, likely within the meadow mat layer, but was immobile under the forces present in the subsurface prior to the start of the Pilot Program. When the temporary access road was constructed, compression of the underlying strata resulted in localized displacement of LNAPL.

#### Summary of Physical Characteristics of Surface and Subsurface Materials - TI Considerations

Pitch Material and impacted soil are distributed laterally and vertically across IAOC A18 and implementation of removal and treatment remedial actions would require access to the entire IAOC A18 area. Due to the physical characteristics of surface and subsurface materials, the equipment size that can access IAOC A18 is limited without extensive surface or subsurface improvement. Because excavating equipment cannot move off the roadway, the amount of Pitch Material and impacted soil that can be removed by excavating equipment is limited to the reach of the excavator when positioned on the roadway or similarly constructed working platform. To access the Pitch Material and impacted soil with conventional equipment needed to implement removal or treatment remedial actions, the surface or subsurface would need to be improved similar to the temporary access road with either a working surface across the IAOC A18 area or multiple access roads. Additionally, bridges would be needed to cross Moses Creek to access the Mudflat Area south of the SWL and the area southeast of the Crude Oil Boat Lines.

In summary, the magnitude and complexity of improvements that would be needed to address the physical characteristics of the surface and subsurface in order to facilitate access to implement removal or treatment remedial actions across the entire IAOC A18 area supports the technically impracticability determination.

#### 3.2.3 Surface Water

A summary of the surface water challenges is as follows:

- Surface water within Moses Creek and Poly Ditch restricts access of conventional equipment to the majority of IAOC A18.
- Due to tidal influence, the surface water within IAOC A18 is variable with the Mudflat Area and the area east of the Poly Ditch being inundated with up to 16 inches of surface water twice a day during half of the lunar cycle.
- Moses Creek and Poly Ditch are operational water bodies in active use by the refinery. Moses Creek is a NJPDES permitted outfall within the BRC with a compliance point at No. 1 Dam with periodic releases of petroleum hydrocarbons resulting from refinery operations. The Poly Ditch is an operational ditch used by the BRC to discharge non-contact cooling water. The BRC normally operates 24 hours



a day, 7 days a week where Morses Creek and Poly Ditch are used for refinery operations. Every effort must be made to minimize the effect of remediation activities on these water bodies, just as with refinery infrastructure in and around IAOC A18.

- The surface water adjacent to or within IAOC A18 creates constructability challenges and presents loss-of-life worker safety risk for remedial action implementation.

The surface water challenges described below increase the magnitude and complexity of removal and treatment remedial action implementation supporting a technical impracticability determination.

#### Access Restrictions – TI Considerations



Exhibit 9 – View of the Mudflat Area south of the SWL, from IAOC E3 (Central Landfill) located across Morses Creek to the southwest.



Exhibit 10 – The southern corner of IAOC A18 facing northeast, viewed from across Morses Creek.



Exhibit 11 – The area to the east of the Poly Ditch, facing east. The Poly Ditch is in the center of the photograph. The IRPL are visible near the top left portion of the photograph and the SWL is visible near the top right portion.

The accessibility challenges were demonstrated during the Pilot Program. During Pilot Program activities, a barge was deployed in Morses Creek to transport equipment and materials from the laydown area at the northwestern portion of IAOC A18 to the Mudflat Area south of the SWL. The barge was later mobilized over land to the southeastern side of the Crude Oil Boat Lines to transport equipment to the southeastern side of IAOC A18. The amount of materials that could be transported via the barge was limited. If removal or treatment of soil south of the SWL was to be conducted, the limitation on the volume of materials that can be transported across Morses Creek would increase the complexity of the remedial alternative, supporting a determination that removal or treatment is technically impracticable. Utilizing multiple crossings of Morses Creek, either via additional barges or temporary bridges, would also increase the magnitude and complexity of a removal or treatment remedial option. Fewer crossings of Morses Creek are expected to be required for a capping/containment remedial option. The Poly Ditch flows from northwest to southeast and enters Morses Creek at the eastern side of IAOC A18. The Poly Ditch transects IAOC A18 and restricts access to the easternmost portion of IAOC A18. As detailed in **Section 3.2.1**, personnel have been able to access the easternmost portion of IAOC A18 via a small rowboat launched from the eastern side of Morses Creek, but motorized equipment has not been capable of accessing this area of the IAOC due to the presence of the Poly Ditch as well as refinery infrastructure.

Due to the access restrictions caused by surface water, materials and equipment would need access the site using a barge or bridges across Morses Creek. If removal or treatment of soil south of the SWL and southeast of the Crude Oil Boat Lines was to be conducted, bridges would be needed to transport materials over or across Morses Creek. The magnitude of the materials that would need to be transported over or across Morses Creek to implement the removal or treatment remedial actions would be extensive, supporting a technical impracticability determination. Fewer crossings of Morses Creek are expected to be required for a capping/containment remedial option.



## Tidal Inundation – TI Considerations



Exhibit 12 – The Mudflat Area and the portion of the former Pitch Disposal Area located south of the SWL, facing southeast, with little to no surface water inundation.



Exhibit 13 – The Mudflat Area and the portion of the former Pitch Disposal Area located south of the SWL, facing southeast, under surface water inundation.

Under the removal remedial action scenario, material removal would be required to a depth of up to approximately 12 fbg across the entire IAOC A18 area. The excavation would need to be shored to hold back Morses Creek and Poly Ditch surface water and sediments and dewatering of the excavation would be needed to facilitate material removal. The management of surface water during removal or treatment of impacted material would increase the magnitude and complexity of the remedial action implementation and present potential loss-of-life safety risks for site workers that would potentially be working within the shored excavation.

#### Re-impacting the Remediated Areas – TI Considerations

Morses Creek, along with its associated channels and ditches, is a NJPDES permitted discharge location within the BRC with a compliance point at No.1 Dam. The Poly Ditch is an operational ditch used by the BRC to discharge non-contact cooling water. Every effort must be made to minimize the effect of remediation activities on these water bodies, just as with other active refinery infrastructure in and around IAOC A18. As a permitted outfall, there is the potential for system upset resulting in releases from ongoing operations to the IAOC A18 area.



Exhibit 14 – Absorbent boom at No. 1 Dam, downstream of IAOC A18.

As Morses Creek is a permitted NJPDES outfall with a compliance point at No.1 Dam, surface water inundation will be a potential ongoing source of impacts to clean fill material placed in this area as part of the remedial actions. Under the removal remedial action scenario, the majority of IAOC A18 would be excavated and backfilled with clean backfill material. The



Morses Creek NJPDES permit establishes effluent limitations and/or monitoring and reporting requirements for contaminants such as petroleum hydrocarbons, oil and grease, select volatile and semi-volatile organic compounds, heavy metals, conventional wastewater parameters, acute toxicity, and other parameters. The actual volume of oil and grease discharged into Morses Creek is unknown to ExxonMobil. However, Phillips 66 is authorized to discharge the constituents and quantities set forth in NJPDES Permit No. NJ0001511 (or as renewed/re-issued). Phillips 66 is permitted to discharge a daily maximum of 2,260 kg/day (approximately 4,982 lbs/day) of oil and grease as measured at the compliance point at No. 1 Dam which is downstream of IAOC A18.

#### Summary of Surface Water – TI Considerations

The presence of surface water bodies limits accessibility to the project area. Surface water inundation would require a perimeter shored excavation and water management during construction; and presents potential loss-of-life worker safety risk. Additionally, the operational condition of Morses Creek and Poly Ditch increase the magnitude and complexity of implementing removal or treatment remedial actions supporting technical impracticability.

#### 3.2.4 Air Emissions

Potential air emissions that may result from removal or treatment remedial action implementation could cause exposure to workers at IAOC A18 and throughout the BRC, and the public due to the proximity of the NJ Turnpike. The size and scope of air emissions controls that would be required for removal or treatment remedial action implementation increases the magnitude and complexity of the project supporting technical impracticability.



Exhibit 15 – The New Jersey Turnpike (right) adjacent to Morses Creek and IAOC A18, as viewed from IAOC E2 (Eastern Landfill) facing northeast.

Hydrogen sulfide, nuisance odors, VOCs and particulate matter are air emissions that have been monitored during historical investigation, PDI, Supplemental PDI and Pilot Program activities. These emissions can have effects ranging from creating a mild nuisance to being potentially life-threatening to site workers and the public.

#### Hydrogen Sulfide – TI Considerations

Hydrogen sulfide ( $\text{H}_2\text{S}$ ) is a colorless gas which is denser than air. It has a rotten egg odor at lower concentrations but is odorless at higher concentrations.  $\text{H}_2\text{S}$  is formed as a byproduct of anaerobic respiration in areas where sulfate reduction occurs. Sulfate reducing conditions are present in the subsurface in IAOC A18, particularly within the meadow mat layer. Additionally,  $\text{H}_2\text{S}$  is a byproduct of multiple processes used within the refinery.  $\text{H}_2\text{S}$  is an asphyxiant and can be flammable or explosive when combined with air. As an example, during Pilot Program activities, a personal  $\text{H}_2\text{S}$  alarm, which is required PPE at the BRC, was triggered for one site worker during excavation of a test pit in the Mudflat Area. The test pit had been completed to approximately 3 fbg at the time that the alarm was triggered. Work was stopped and all site workers left the area until it could be confirmed that  $\text{H}_2\text{S}$  was no longer present in the work area. It is believed that the  $\text{H}_2\text{S}$  encountered was the byproduct of anaerobic respiration rather than a release from a refinery process area, but the same procedures are followed regardless of the suspected source as a means to protect worker safety. It is expected that excavation of Pitch Material and/or Mudflat Area soil would result in additional releases of naturally-occurring  $\text{H}_2\text{S}$  as the excavation progressed to depths

where sulfate reducing conditions are present. This would result in additional, possibly frequent work stoppage, and potential risks to worker safety. The risk of worker exposure to H<sub>2</sub>S would be lowered by limiting or eliminating the amount of excavation in IAOC A18 to the amount required to facilitate installation of a capping/containment remedy. Engineering controls such as enclosed structures around and over excavation areas, and additional PPE such as respirators or self-contained breathing apparatus (SCBA) could be utilized but the use of these controls would increase the magnitude and complexity of a removal or treatment option.

#### Nuisance Odors – TI Considerations

Nuisance odors were generated during intrusive Pilot Program activities. Personal and work zone air monitoring was conducted throughout the Pilot Program and conditions were usually suitable for the work to be conducted. Although not quantifiable, odors generated in the work area affected the work progression due to frequent stoppages and work breaks. For a larger excavated area, there would likely be nuisance odor concerns within other operational units of the BRC as well as offsite due to variable wind directions and the proximity of IAOC A18 to the NJ Turnpike.

#### Public and Worker Exposure – TI Considerations

The public is at a lower risk of exposure to contaminants present in IAOC A18 than site workers are simply based on distance from the source of the contaminants. However, airborne particulate matter, hydrocarbon vapors and odors can be transported offsite and can potentially affect offsite receptors. During Pilot Program activities, perimeter air monitoring equipment, including meters to measure VOC and particulate matter concentrations, was used at upwind and downwind locations to monitor for potential emissions from the site. A Community Air Monitoring Program (CAMP) was established to monitor emissions of VOCs, PAH compounds, metals and particulate matter that would potentially be generated during ground-intrusive activities during the Pilot Program. Benzene was selected as an indicator compound for VOCs based on soil and ground water data for IAOC A18, and because it has the lowest OSHA Permissible Exposure Limit (PEL) value. It should be noted that ExxonMobil's Occupational Exposure Limit for benzene (0.5 parts per million) is lower than the OSHA PEL of 1 part per million. Particulate matter was selected as an indicator of the potential presence of PAH and metals based on their tendency to adsorb to particulate matter. Benzene and particulate matter were not detected at concentrations exceeding the thresholds specified in the CAMP during Pilot Program activities. It should be noted that activities conducted while the air monitoring program was being implemented which could potentially generate VOC or particulate matter were limited in areal extent and depth and resulted in less disturbance to existing materials than would be expected during a removal or treatment remedial action. These activities consisted of the following:

- Construction of the temporary access road.
- Excavation of one test pit in the former Pitch Disposal Area and one test pit in the Mudflat Area (approximately 5 feet long, 5 feet wide and 4 feet deep).
- Installation of sheet piles around part of the capping test cell in the former Pitch Disposal Area.
- Geotechnical borings and monitoring well installation in the former Pitch Disposal Area and Mudflat Area.

Increasing the amount of excavation and intrusive work within IAOC A18 will increase the risk of airborne transport of site contaminants to offsite areas, and potentially affect offsite receptors. While site controls can be implemented, to minimize VOC and particulate matter transported offsite, it is not practicable to control all potential emissions. The BRC is located near a waterway (Arthur Kill) where weather conditions can change frequently and rapidly. Changes in wind speed and direction can occur, often with little to no advance warning. This could lead to uncontrolled emissions of VOCs and/or particulate matter before controls can be implemented. A removal or treatment remedial action would likely require a more extensive air monitoring and emission control program than a capping/containment remedial action.

#### Summary of Air Emissions – TI Considerations

By limiting the amount of material to be removed to only what is required for the installation of a containment remedy, the risks to worker safety and public health from emissions of H<sub>2</sub>S, nuisance odors, VOCs and particulate matter would be minimized.

### 3.3 Technical Impracticability Evaluation Summary

This section detailed the applicability of NJDEP regulations and guidance as well as technical impracticability considerations for removal or treatment remedial action alternatives for IAOC A18. The NJDEP regulations and guidance, and the associated site-specific applicability, considered in this section include:

- NJDEP's April 30, 2019 letter regarding the RFSR;
- NJDEP's EPH Guidance; and
- NJDEP's *Technical Impracticability Guidance for Groundwater* (NJDEP, 2013c).

The NJDEP's EPH guidance acknowledges that compliance with the EPH product limit may be impracticable for meeting the requirement at N.J.A.C. 7:26E-5.1(e) to treat or remove free product and residual product at large or complex non-residential sites. The BRC is a large, active refinery and petroleum storage facility consistent with the description included in the NJDEP's EPH Guidance. As referenced in the NJDEP's *Technical Impracticability Guidance for Ground Water* (NJDEP, 2013c), the 1993 USEPA guidance document, *USEPA Office of Solid Waste and Emergency Response Directive 9234.2-25*, acknowledges that there may be cases where remediation may be technically possible, but the scale of the operations required may be of such magnitude and complexity that the remedial alternative would be

impracticable. The details presented in this section support the determination that the magnitude and complexity of implementing a removal or treatment remedial action would make such an option technically impracticable. Factors contributing to this technical impracticability determination include limitations imposed by third party ownership; access limitations imposed by active refinery infrastructure; physical characteristics of surface and subsurface materials; surface water; and air emissions. The proposed capping and containment remedial action utilizes proven remediation technologies that are consistent with the RCRA CMS (USEPA, 2003), the TRSR (N.J.A.C. 7:26E-5.1; NJDEP, 2018b) and the NJDEP-approved Road Map (Kleinfelder, 2018a). Additionally, the capping and containment remedial action approach for IAOC A18 would be consistent with remedial actions implemented at other IAOCs at the BRC, such as, the Sludge Lagoon Operable Unit (SLOU) designated as IAOC L. The capping and containment remedial action for the SLOU contains LNAPL and petroleum hydrocarbon from a variety of sources at the BRC, including asphalt recovered from a release that occurred in IAOC B2 in 1982, which is similar to Pitch Material in composition and physical properties. The SLOU Corrective Action Report (CAR) was approved by the LSRP and NJDEP on November 7, 2016 and containment and hydraulic control continues to be documented in the Semi-Annual Progress Reports. A capping and containment remedial action offers the following advantages over removal or treatment remedial alternatives evaluated for IAOC A18:

- A capping and containment remedial alternative will have less impact on the refinery operations and will pose less risk of damage to or failure of critical refinery infrastructure.
- The magnitude and complexity of the improvements that would be needed to address the physical characteristics of the surface and subsurface materials in IAOC A18 in order to facilitate access to implement removal or treatment remedial actions across the entire IAOC A18 area supports the technical impracticability determination.
- Access limitations and constructability challenges associated with surface water bodies (Morses Creek and the Poly Ditch) and surface water inundation of the Mudflat Area surface are expected to have a greater impact on a removal or treatment remedial action than on a capping/containment remedial action because of the greater amount of materials that would need to be excavated, handled and transported.
- A removal or treatment remedial action requires greater disturbance of the surface and subsurface materials than a capping/containment remedial action, which would increase the risk of exposure to contaminants for site workers, other workers within the BRC and the public. Engineering controls such as enclosed structures around and over excavation areas, and additional PPE such as respirators or SCBA could be utilized, but the use of these controls would increase the magnitude and complexity of a removal or treatment option.

## 4 SCHEDULE

The anticipated schedule for completion of in-progress and future activities for IAOC A18 is included below.

Activity	Anticipated Completion
<i>Pilot Program Completion Report</i>	December 2020
<i>RFSR Addendum</i>	December 2020
Onsite meeting with NJDEP Case Manager and NJDEP technical staff to review <i>Pilot Program Completion Report</i> , <i>RFSR Addendum</i> and <i>Technical Impracticability Report</i>	January 2021
NJDEP approval of <i>Technical Impracticability Report</i> , Pilot Program Completion Report, <i>RFSR</i> and <i>RFSR Addendum</i>	March 2021
Completion of long-term monitoring of Pilot Program elements including capping test cells, wetland vegetation test cells, alternative capping technologies and the temporary access road	March 2021
RAW submittal	September 2021
NJDEP Approval of RAW	December 2021
Final design	April 2022
Contractor procurement and permitting	August 2022
Initiate remedial action construction	November 2022

## 5 REFERENCES

---

- AMEC Earth & Environmental, Inc. (AMEC). 2005. *Revised Comprehensive Baseline Ecological Evaluation*, Bayway Refinery, Linden, New Jersey.
- Arthur D. Little, 1994. *Baseline Ecological Evaluation: Ecological Report - Bayway Refinery, Linden, New Jersey*.
- Arthur D. Little, Inc. 1997. *Supplemental Remedial Investigation Report - Bayway Refinery, Linden, New Jersey*. August 1997.
- Arthur D. Little, Inc. 2000. *Bayway Phase 1B Remedial Investigation Report - Bayway Refinery, Linden, New Jersey*. October 2000.
- Dan Raviv Associates, Inc. (DRAI). 2000. *Verification of Class III-B Ground Waters - Bayway Refinery, Linden, New Jersey*. April 2000.
- DRAI. 2001. *Proposed Alternatives, Site Specific Ground Water Quality Criteria for the Class III-B Area*. June 2001.
- DRAI. 2003. *Remedial Action Selection Report — Pitch Area IAOC, Linden, New Jersey*. January 2003.
- ExxonMobil. 2015. *Response to NJDEP's March 9, 2015 Comments on the Pitch Area Investigative Area of Concern A18 Pre-Design Investigation Work Plan*. July 15, 2015.
- Geraghty & Miller. 1993. *Site History Report, Bayway Refinery, Linden, New Jersey*. February 1993.
- Geraghty & Miller. 1995. *Phase IA Remedial Investigation Interim Report, Bayway Refinery, Linden, New Jersey*. May 1995.
- Kleinfelder. 2015. *Pre-Design Investigation Work Plan for Pitch Area Investigative Area of Concern (IAOC) A18, Bayway Refinery Complex, Linden, New Jersey*. January 2015.
- Kleinfelder. 2018a. *Remediation Strategy Road Map for the Bayway Refinery Complex, Linden, New Jersey (Revision 5.0)*. March 2018.
- Kleinfelder. 2018b. *Revised Feasibility Study Report*. August 31, 2018.
- New Jersey Department of Environmental Protection (NJDEP). 1991. *Administrative Consent Order*. November 27, 1991.
- NJDEP. 1993. *Administrative Consent Order Amendment*. April 8, 1993.
- NJDEP. 1994. *Administrative Consent Order Amendment*. December 22, 1994.
- NJDEP. 2010a *Phase-in for the implementation of the 'Protocol for Addressing Extractable Petroleum Hydrocarbons' and the associated analytical method Analysis of Extractable Petroleum Hydrocarbon Compounds (EPH) in Aqueous and Soil/Sediment/Sludge Matrices" - Version 3.0 (EPH Phase-in)*, dated August 9, 2010.

- NJDEP. 2010b. *Protocol for Addressing Extractable Petroleum Hydrocarbons (EPH) in Aqueous and Soil/Sediment/Sludge Matrices* - Version 3.0, August 9, 2010.
- NJDEP. 2013a. *Approval of September 2012 Ecological Remedial Investigation Workplan*, Bayway Refinery Complex, Linden, New Jersey. April 2013.
- NJDEP. 2013b. *Development of Impact to Ground Water Soil Remediation Standards Using the Soil-Water Partition Equation*, Version 2.0 - November 2013.
- NJDEP. 2013c. *Technical Impracticability Guidance for Ground Water*, Version 1.0. December 3, 2013.
- NJDEP. 2014a. *Comments on March 2014 Ecological Remedial Investigation Report*, Bayway Refinery Complex, Linden, New Jersey. April 2014.
- NJDEP. 2014b. *ExxonMobil's Compliance with May 7, 2014 Remedial Investigation Complete Statutory Deadline*, Bayway Refinery, Linden, New Jersey. May 7, 2014.
- NJDEP. 2014c. *Bayway Refinery - Review of ExxonMobil's March 20, 2014 Ecological Remedial Investigation Report and ExxonMobil's May 5, 2014 Ecological Remedial Investigation Report Addendum*, Bayway Refinery, Linden, New Jersey. May 23, 2014.
- NJDEP. 2014d. *Comments on ExxonMobil's Feasibility Study Report for the Pitch Area, Investigative Area of Concern (IAOC) A18, dated July 2014*. October 10, 2014.
- NJDEP. 2015a. *Approval letter for ExxonMobil's May 5, 2015 Supplemental Site-Wide Remedial Investigation Report, Bayway Refinery Complex and ExxonMobil's Responses to NJDEP Comments Letters dated October 10, 2014 on ExxonMobil's Supplemental Site Wide Remedial Investigation Report Bayway Refinery Complex*. September 21, 2015.
- NJDEP. 2015b. *Comments on January 2015 Pre-Design Investigation Work Plan for Pitch IAOC A18*. March 9, 2015.
- NJDEP. 2015c. *Letter response to ExxonMobil's January 29, 2015 Pre-Design Investigation Workplan for the Pitch Area Investigative Area of Concern (IAOC) A-18 and ExxonMobil's July 15, 2015 Response to the NJDEP's March 9, 2015 Comments to the Pre-Design Investigation Workplan for the Pitch Area IAOC A-18*. July 27, 2015.
- NJDEP. 2015d. *Approval letter for ExxonMobil's Proposed Classification Exception Area dated July 21, 2015*. July 22, 2015.
- NJDEP. 2016. *Electronic mail – ExxonMobil – Pitch Meeting Follow-Up*. April 26, 2016.
- NJDEP. 2017. *N.J.A.C. 7:26D: Remediation Standards*. September 18, 2017.
- NJDEP. 2018a. *Ecological Evaluation Technical Guidance* - Version 2.0, August 2018.
- NJDEP. 2018b. *N.J.A.C. 7:26E - Technical Requirements for Site Remediation*. August 6, 2018.
- NJDEP. 2018c. *N.J.A.C. 7:9C - Ground Water Quality Standards*. August 9, 2018.



- NJDEP. 2018d. Approval letter for *the Bayway Refinery Remediation Strategy Road Map, Revision 5 dated March 2018*. December 10, 2018.
- NJDEP. 2019. *Evaluation of Extractable Petroleum Hydrocarbons in Soil Technical Guidance* – Version 1.0. June 2019.
- State of New Jersey. 2019. *N.J.S.A. 58:10C. Site Remediation Reform Act (Amended)*. August 23, 2019.
- New York State Department of Environmental Conservation (NYSDEC). 2011. *DER-31 / Green Remediation*. DEC Program Policy, Office of Remediation and Materials Management. January 20, 2011.
- TRC Environmental Corporation (TRC). 2011. *Remediation Strategy Road Map for the Bayway Refinery, Linden, New Jersey*. November 2011.
- TRC. 2012a. *Supplemental Site-Wide Remedial Investigation Workplan, Linden, New Jersey*. April 18, 2012.
- TRC. 2012b. *Remediation Strategy Road Map for the Bayway Refinery (Revision 1.0), Linden, New Jersey*. June 2012.
- TRC. 2012c. *Bayway Refinery Ecological Remedial Investigation Workplan, Linden, New Jersey*. September 2012.
- TRC. 2013a. *Addendum to Bayway Refinery Ecological Remedial Investigation Workplan, Bayway Refinery Complex, Linden, New Jersey*. February 2013.
- TRC. 2013b. *Ecological Remedial Investigation Workplan Addendum Response to NJDEP March 1, 2013 Comment, Linden, New Jersey*. March 21, 2013.
- TRC. 2013c. *Feasibility Study Workplan — Pitch Area Investigative Area of Concern (IAOC) A18. Bayway Refinery Complex, Linden, New Jersey*. March 2013.
- TRC. 2013d. *Remediation Strategy Road Map for the Bayway Refinery (Revision 2.0), Linden, New Jersey*. September 2013.
- TRC. 2014a. *Ecological Remedial Investigation Report, Bayway Refinery, Linden, New Jersey*. March 20, 2014.
- TRC. 2014b. *Ecological Remedial Investigation Report Addendum, Bayway Refinery, Linden, New Jersey*. Revised, May 5, 2014.
- TRC. 2014c. *Supplemental Site-wide Remedial Investigation Report, Bayway Refinery Complex, Linden, New Jersey*. May 5, 2014.
- TRC. 2014d. *Feasibility Study Report for the Pitch Area: Investigative Area of Concern – IAOC A18*. July 2014.
- TRC. 2014e. *Remediation Strategy Road Map for the Bayway Refinery (Revision 3.0), Linden, New Jersey*. July 2014.

TRC. 2016. *Remediation Strategy Road Map for the Bayway Refinery (Revision 4.0)*, Linden, New Jersey. September 2016.

TRC Raviv Associates, Inc. (TRC Raviv). 2004a. *Revised Remedial Action Selection Report —Pitch Area IAOC — Unit A*, Linden, New Jersey. February 20, 2004.

TRC Raviv. 2004b. *Bayway Refinery Phase 2 Remedial Investigation Report*. April 30, 2004.

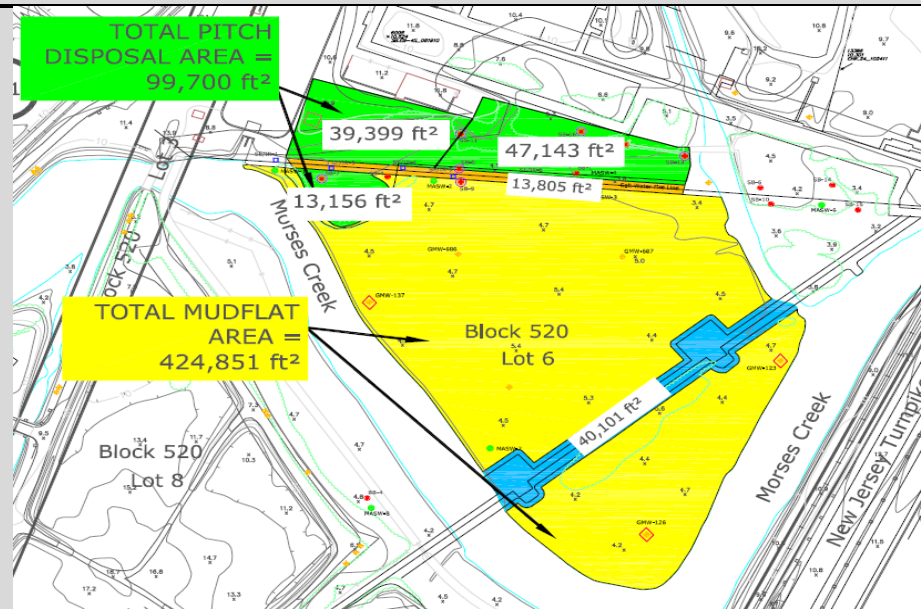
TRC Raviv. 2005. *Remedial Action Workplan — Pitch Area, Linden, New Jersey*. October 5, 2005.

USEPA. 2003. *RCRA Corrective Action, Corrective Measures Study*. Office of Pollution Prevention and Resource Conservation Policy and Guidance. DOE/EH-413-047r. August 2003.

## TABLE

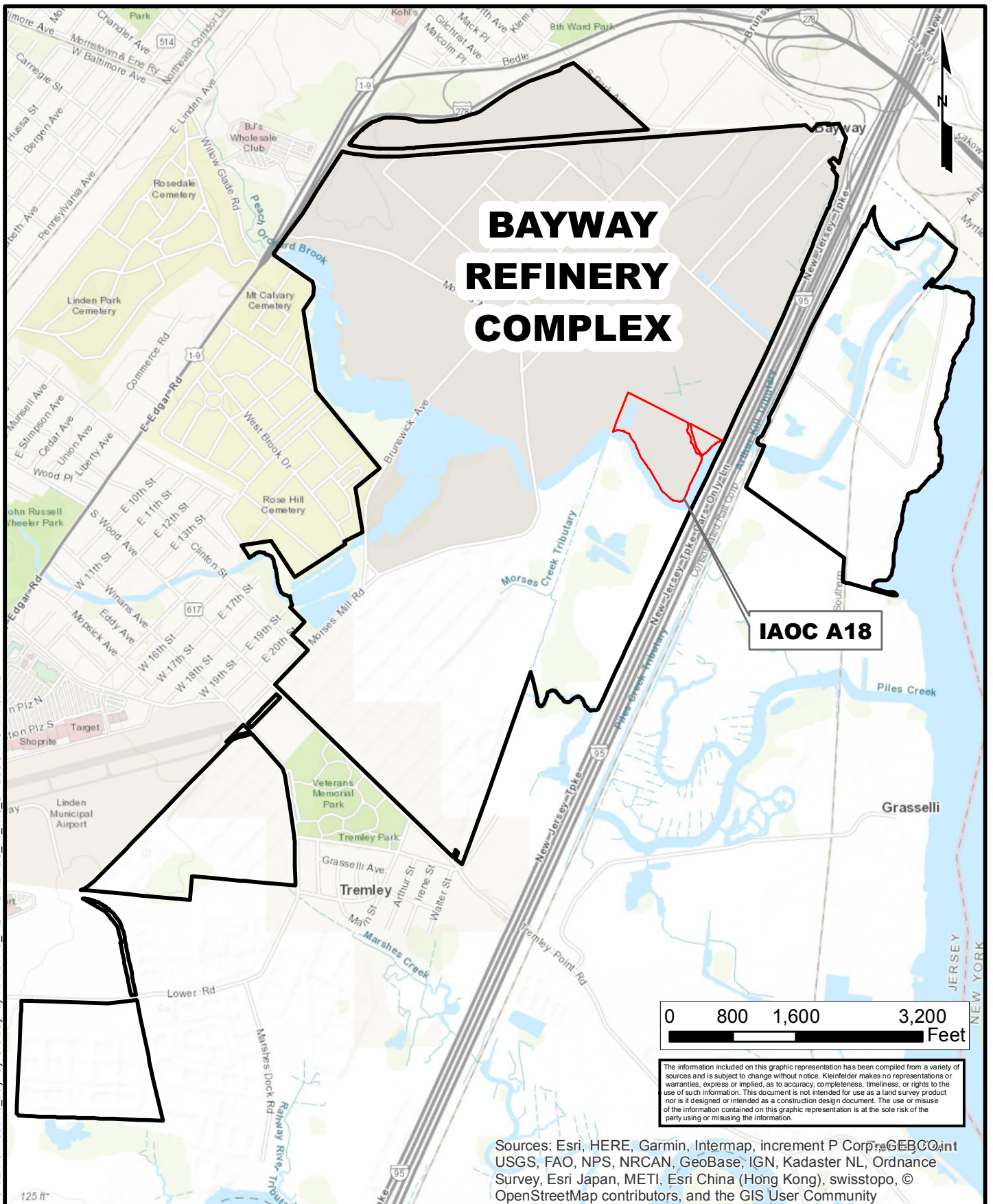


**Table 1**  
**Analysis of Remedial Alternatives**  
IAOC A18  
Bayway Refinery Complex - Linden, New Jersey

Site Plan View		Mudflat Area Description	Former Pitch Disposal Area Description	Remedial Action Objectives	Compressibility of Layers	Infrastructure Description	Prior Repairs to the SWL	Site Access and Staging
		<p>The Mudflat Area is 9.75 acres and is subject to tidally-influenced inundation from Morses Creek up to two times per day, depending on lunar cycle. The majority of the Pitch Area and all of the Mudflat Area is located in NJDEP jurisdictional wetlands and associated transition areas. The lithology of the Mudflat Area is as follows:</p> <p>Layer 1 (Ground at +4 to +3 ft): Former dredge spoils from Morses Creek. Impacts within this material include pitch material which can appear at the surface during warmer temperatures.</p> <p>Layer 2 Meadowmat (top of layer at +1 to -1 ft): Highly organic, highly compressible peat material saturated with varying amounts of impacts.</p> <p>Layer 3 Alluvial Deposits (top of layer at -6 to -8 ft): Loose sands and soft clays with variable amounts of gravel.</p> <p>Layer 4 Till (top of layer at -10 ft): Stiff silts with variable amounts of gravel and sands.</p> <p>Layer 5 Bedrock (top of layer at -14): Fractured Shale typical of the upper Passaic Formation.</p>	<p>The Pitch Disposal Area is an upland area adjacent to the Mudflat Area and is generally divided into two areas:</p> <ul style="list-style-type: none"><li>• Lobe Area: 0.3 Acre area south of the SWL with pitch extending to 8 ft bgs.</li><li>• Deep Area: 2 Acre area north of the SWL with pitch extending 4 to 8 ft bgs.</li></ul> <p>The lithology of the Pitch Disposal Area is the same as the Mudflat Area except for Layer 1. Layer 1 for the Pitch Disposal Area is described below:</p> <p>Layer 1 (Former Pitch Disposal Area) (Ground surface at +5 to +7 ft): Pitch material consisting of low-volatility, low-pH, soft and highly compressible, dark viscous material with approximately 80% solids content. During hot summer months, the surficial material can liquify and become more mobile.</p> <p>When excavated the pitch material emits noxious odors.</p>	<p>The COCs in soil for the Pitch Area include benzene, benzo(a)anthracene, benzo(a)pyrene, naphthalene, arsenic, lead, and TPH. The COCs in groundwater for the Pitch Area include benzene, VOCs, SVOCs, arsenic and lead. The objectives of the remedial action will be to implement a remedy which achieves the following:</p> <ul style="list-style-type: none"><li>• Prevent potential for direct human exposure to contaminated soils via ingestion, inhalation and dermal contact.</li><li>• Prevent potential for mechanical transportation of contaminated soils to environmental receptors.</li><li>• Prevent exposure of contaminated soil to biota.</li><li>• Prevent introduction of heavy metals dust to avian species.</li><li>• Remove, treat, or contain Pitch Material and/or Separate Phase Material to the extent possible.</li><li>• Remove, treat, or contain the contaminated ground water from the Site.</li><li>• Promote the use of green and sustainable practices and technologies.</li></ul> <p>One-dimensional consolidation tests ran on the pitch material, dredge spoils and meadowmat indicate that all three materials are highly compressible. Material consolidation could result in mobilization of NAPLs.</p> <p>Three dimensional settlement analyses using the computer program rocsience indicate that if a 2-foot cap were to be placed on the material, up to 8 inches of consolidation would be observed within the Pitch Disposal Area and up to 15 inches of consolidation would be observed in the Mudflat Area.</p>		<p>The above-ground pipelines include two 30-inch crude oil lines (Boat Lines), intra-refinery pipelines (IRPL), high pressure steam lines, and a 60-inch cooling water pipeline (Salt Water Line [SWL]) which supplies the refinery with 100,000 gpm. The pipelines are supported by timber piles bearing on fractured bedrock.</p> <p>LPILE evaluation indicates that induced settlement of 1 inch may result in overstressing the piles; however, this analysis may be overly conservative given the history of repairs to the utilities.</p>	<p>Replacement of the SWL supports on an adjacent section was conducted in 2003. During that replacement, steel H-pile supports were driven with an 1,500 ft-lb impact hammer a minimum of 4 feet into the fractured bedrock. The replacement piles were driven within 3 feet of the existing timber piles. Vibration monitoring limits during construction were 1.0 in/sec.</p> <p>Pile support repairs for the SWL were conducted in 2007 and included excavating up to 4 feet of exposed pile, pouring concrete pile caps on approximately 20% of piles and installing steel sleeper supports.</p>	<p>The Mudflat Area and the Pitch Disposal Area are unstable and cannot support traditional earth moving equipment without some type of structural improvement.</p> <p>The boat lines and the SWL traverse the areas and heavy equipment will not be able to cross over them.</p> <p>The majority of the Pitch Disposal Area can be accessed from the north. Temporary bridges will likely be required to access the pitch lobe south of the SWL and the Mudflat Area.</p>
General Remedial Strategies/Technologies	Remedial Technology and Process Options	Remedial Technology and Process Option Description	Compliance/Effectiveness of Remedial Strategy	Constructability/Site Access/Feasibility		Waste Transport and Disposal	Impacts on Refinery Infrastructure (Pipelines)	Long Term O&M
Technology 1 Monitored Natural Attenuation	Long Term Monitoring and Release Response	No active remediation; Continued monitoring of releases and long-term natural degradation of impacts.	This alternative would not satisfy the majority of the RAOs and is unlikely to gain regulatory acceptance.	Remedy does not require any construction.		No transportation and disposal of material required outside of long term release response.	The SWL and Boat Lines would be unaffected by this remedy.	Releases to Morses Creek could continue and pitch material would continue to be exposed at the surface. O&M would be required to mitigate any releases.
Technology 2 Excavation	Conventional Excavation	Removal, transportation, and disposal of impacted material utilizing traditional excavation and construction equipment. Although the Pitch Disposal Area is not impacted by the tidally-influenced inundation observed in the Mudflat Area, the excavations would extend below the water line of Morses Creek. Excavation using conventional equipment would require installation of a perimeter hydraulic barrier and significant dewatering efforts to maintain the water below the excavation bottom. Also, the highly compressible materials would require structural improvement for accessibility.	Removal of the impacted material would satisfy the RAOs.	Removal of impacted material using conventional construction equipment would require significant dewatering (likely including perimeter containment) and odor suppression. Structural improvement of highly compressible materials would be needed to facilitate access and additional handling/processing of excavated materials may be necessary for dewatering and to prepare the materials for off-site transportation/disposal. Structural improvements would be required to construct access roads and footings for temporary bridges over Morses Creek; would also need to remove portions of sunshade bridge and associated out-of-service piping.		Much of the waste may not be suitable for disposal at a landfill without stabilization and/or amendments. Despite dewatering activities, some soils will likely require additional dewatering, amendment addition and water treatment costs.	Removal of material beneath the SWL, boat lines and/or intra-refinery pipelines may require hand excavation and will require extensive monitoring and/or supports to minimize potential impacts to the timber pilings.	Minimal long-term O&M due to source removal
	Amphibious Equipment	Removal, transportation, and disposal of impacted material utilizing specialty amphibious excavation and construction equipment. Although the Pitch Disposal Area is not impacted by the tidally-influenced inundation observed in the Mudflat Area, the excavations would extend below the water line of Morses Creek. Excavation using amphibious equipment could be sequenced without using a perimeter hydraulic barrier. Large staging and material handling areas would be required to dewater the excavated materials and prepare those materials for off-site transportation/disposal.		Removal of impacted material using amphibious or dredging equipment would require significant handling, dewatering, and/or amendments to make the excavated materials suitable for off-site transportation/disposal. This approach would require multiple, large material dewatering/stockpile areas, dewatered liquid collection and treatment and odor suppression. The use of amphibious or dredging equipment would reduce the need to construct onsite access roads; however, removal of the sunshade bridge and associated out-of-service piping, and riverbank improvements would be needed along Morses Creek to gain access for amphibious or dredging equipment.		Much of the waste may not be suitable for disposal at a landfill without stabilization and/or amendments. Performing excavations in the wet would require significant additional dewatering, amendment addition and water treatment costs.	Slip-lining of the SWL has been evaluated to reduce the potential for releases; however, slip-linomg would only mitigate releases associated with minimal excavation-induced movement.	
	Dredge Removal	Removal, transportation, and disposal of impacted material utilizing dredging equipment. Although the Pitch Disposal Area is not impacted by the tidally-influenced inundation observed in the Mudflat Area, the excavations would extend below the water line of Morses Creek. Dredge equipment gain access from Morses Creek, creating a sufficiently deep berth to access the mudflat for additional material removal. Large staging and material handling areas would be required to dewater the excavated materials and prepare those materials for off-site transportation/disposal.					Alternatively, the lines could be relocated at a significant cost, though the footprint and design of the relocation pipeline would need to be determined.	
Technology 3 Capping	Reactive Cap	A reactive cap consisting of reactive media laver overlain by clean soil materials would be installed over the impacted pitch and mudflat soils to physically isolate impacts. Installation of cap materials over the highly compressible soils could lead to upward mobility of NAPL and/or impacted groundwater, which would be treated by a reactive media layer (e.g., organo-clay or carbon).	When coupled with perimeter containment, a reactive cap or an impermeable cap would be in compliance with the RAOs. Long-term liability would remain.	The pitch material, meadowmat, and mudflat dredge spoils are expected to consolidate up to 8 tpo 15 inches under the load of a two foot thick cap. This could cause NAPL and/or impacted groundwater to migrate upward. Significant quantities of NAPL could quickly exhaust the reactive media and potentially impact the protective cover soil. Potential for reimpacts to capping materials associated with tidally-influenced inundation from Morses Creek. Site access requirements expected to be similar to excavatoin options; however, fewer access roads would be needed.		Handling and transportation of pitch or mudflat soils would only be required as necessary to install grade or install the cap materials (see above for considerations associated with transportation and disposal of impacted material).	The placement of a cap will be the least intrusive remedy around the utilities, but may require hand placement/booting to timber supports. Given that the utility supports are embedded in the underlying weathered bedrock, the consolidation of the surficial capping material may not have a significant impact on the timber piles. Alternate capping technologies (spray liner, aquablok) are also being evaluated for use beneath the utilities.	Replacement of the reactive cap material would be required after sorptive capacity has been reached. Upward mobility of NAPL or impacted groundwater from cap loading may reduce life of cap. Long-term groundwater monitoring likely required.
	Impermeable Cap	An impermeable cap such as a linear, low-density polyethylene [LLDPE] overlain by clean soil materials would be installed on top of the impacted media to physically isolate the impacted soil, groundwater, and NAPL. Installation of cap materials over the highly compressible soils could lead to increased mobility of NAPL, which would be collected in drainage features installed within and/or along the perimeter of the cap. In addition, the impermeable cap would include vents to prevent gas buildup beneath the liner.		The LLDPE liner would be designed to deform with the consolidation and seasonal movement of the cap materials. As the pitch and mudflat material consolidate NAPL would be collected via a drainage collection system within/around the perimeter of the cap. Also, any gases generated beneath the liner would be release via vents installed in the cap. Potential for reimpacts to capping materials associated with tidally-influenced inundation from Morses Creek. Site access requirements expected to be similar to excavatoin options; however, fewer access roads would be needed.				Short term O&M would involve NAPL collected during consolidation of cap. Minimal long-term O&M for cap maintenance over life span (assumed 50 years). Long-term groundwater monitoring likely required.
Technology 4 Perimeter Containment / Treatment	Slurry Wall	An impermeable vertical barrier would be installed around the entire perimeter of the IAOC. This barrier would prevent the migration of water in or out of the IAOC. The barrier would be installed from ground surface using either traditional or amphibious excavation equipmentand tied into the bedrock. The slurry wall would consist of a mixture of sand and attapulgite clay to resist the low pH nature of the contaminants over the life span of the wall.	When coupled with a surficial cap option, full vertical containment would be in compliance with the RAOs though long term liability would remain.	A slurry wall consisting of attapulgite and sand would have minimal material strength and may deform and rupture as materials on the upgradient side consolidates while materials on the downgradient side remain static. Installation of the working platform to allow slurry wall installation on the exact downgradient perimeter of the site will be difficult, likely leaving an impacted "wedge" of soil outside the containment.		Handling and treatment considerations for any material displaced by the slurry would be similar to excavated materials. A large working platform would need the be installed around the perimeter of the mudflat area. The slurry batch plant would need to be located away from the work area, requiring several slurry booster pumps to get the slurry material to installation location, which could cause workability issues.	Vertical hydraulic containment beneath the active utilities would need to be conducted using an alternative technology such as jet grouting, which could be angled under the utilities and between the timber supports while minimally impacting the timper piles. Alternatively, gaps in the perimeter containment could be left under the utility lines and groundwater extraction wells could be used to create an inward hyraulic gradient.	Minimal maintenance is anticipated for perimeter slurry or sheet pile wall. GW monitoring may be required to demonstrate hydraulic control of impacted groundwater, especially if gaps left in the wall beneath the utilities.
	Sheet pile Wall	An impermeable vertical barrier would be installed around the entire perimeter of the IAOC. This barrier would prevent the migration of water in or out of the IAOC. The barrier would be installed from ground surface using a barge mounted crane adjacent to Morse's Creek and tied into the bedrock. The sheet pile wall would be designed to have a sacrificial steel thickness which would resist the low pH of the material over the design life of the wall.		The installation of steel sheet piles from ground surface into the underlying bedrock could be conducted by barge-mounted equipment or conventional equipment following structural improvement for access roads. Similar driving technologies have been implemented immediately adjacent to the SWL in the past. The sheet pile interlocks would be sealed with low permeability material and the tips of the sheets would be fitted with reinforcing driving shoes to maximize embedment into through the till and fractured bedrock.		The majority of the sheet pile wall could be installed from a barge within Morses Creek, thus avoiding the need to create a perimeter working platform and/or access roads along the perimeter of the mudflat.		
		Permeable Reactive Barrier/ Funnel & Gate	An impermeable vertical barrier would be supplemented by a permeable reactive barrier installed along all or a portion of the downgradient perimeter to passively treat groundwater leaving the IAOC. The treatment would need to include multiple media layers to treat both metals and hydrocarbon impacts. The barrier would be installed using either traditional excavation equipment with trenches supported with a biopolymer slurry, or via a one-pass trenching system.	When coupled with a surficial cap option, using a PRB to treat groundwater migrating off site would be in compliance with the RAOs though long term liability would remain.	Installaton of the working platform to allow slurry wall installation on the exact downgradient perimeter of the site will be difficult, likely leaving an impacted "wedge" of soil outside the containment. A funnel and gate system would require the ability to mound and direct groundwater which would be difficult within a tidally-influenced mudflat.		Handling and treatment considerations for any material displaced by the PRB would be similar to excavated materials. A large perimeter working platform would need the be installed similar to the slurry wall construction.	
Technology 5 In-Situ Treatment	Solidification	The impacted material at the Site would be solidified in-situ within a low-permeability mass which would isolate the impacts from the surrounding soil and groundwater. The material would be solidified by adding binding reagents such as Portland cement or blast furnace slag. The mixing would be conducted using excavator mounted mixers such as ALLU tools.	Solidification of the impacted material would be considered containment and would be in compliance with the RAOs.	Preliminary ISS treatability test results performed by JLT indicate that the pitch material is too saturated with NAPL to effectively hydrate the blast furnace slag or portland cement. Even with a 20% addition of solidification reagents, and with bulking upwards of 50-100%, the treated material may not be capable of passing leachability requirements. The entire site would need to be accessed by heavy equipment to mix the impacted material with reagents, which could be challenging due to the highly compressible nature of the materials.		Solidification or stabilization both require extensive reagent material handling activities. Stabilization/solidification would typically require little if any handling or disposal of impacted materials. However, given the anticipated amount of swelling, t+H36he increase in bulked material would require removal and off-site disposal of solidified or stabilized material to maintain existing grades.	Any significant swell associated with solidification or stabilization would likely cause unacceptable impacts to the timber supports for the pipelines.	Long-term GW monitoring expected to document that no further leaching/impacts to groundwater from solidified mass.
	Stabilization	The impacted material at the Site would be stabilized in-situ into less toxic forms that would not negatively impact soil or groundwater quality. The material would be solidified by adding stabilizing reagents such as activated carbon to treat hydrocarbons and zero-valent iron to treat arsenic. The mixing would be conducted using excavator mounted mixers such as ALLU tools.	Destruction of the impacts to below soil and groundwater standards would be in compliance with the RAOs and would eliminate long term liability.	Stabilization of the material would need to be conducted for both the organic and metals impacts. The presense of free phase NAPL in the pitch material is not compatible with this technology. The entire site would need to be accessed by heavy equipment to mix the impacted material with reagents, which could be challenging due to the highly compressible nature of the materials.				If successfully implemented, little long term O&M would be required outside of confirmatory groundwater monitoring.
Indicates Preferable Aspect								
Indicates Reasonably Acceptable Aspect								
Indicates Unsatisfactory Aspect								

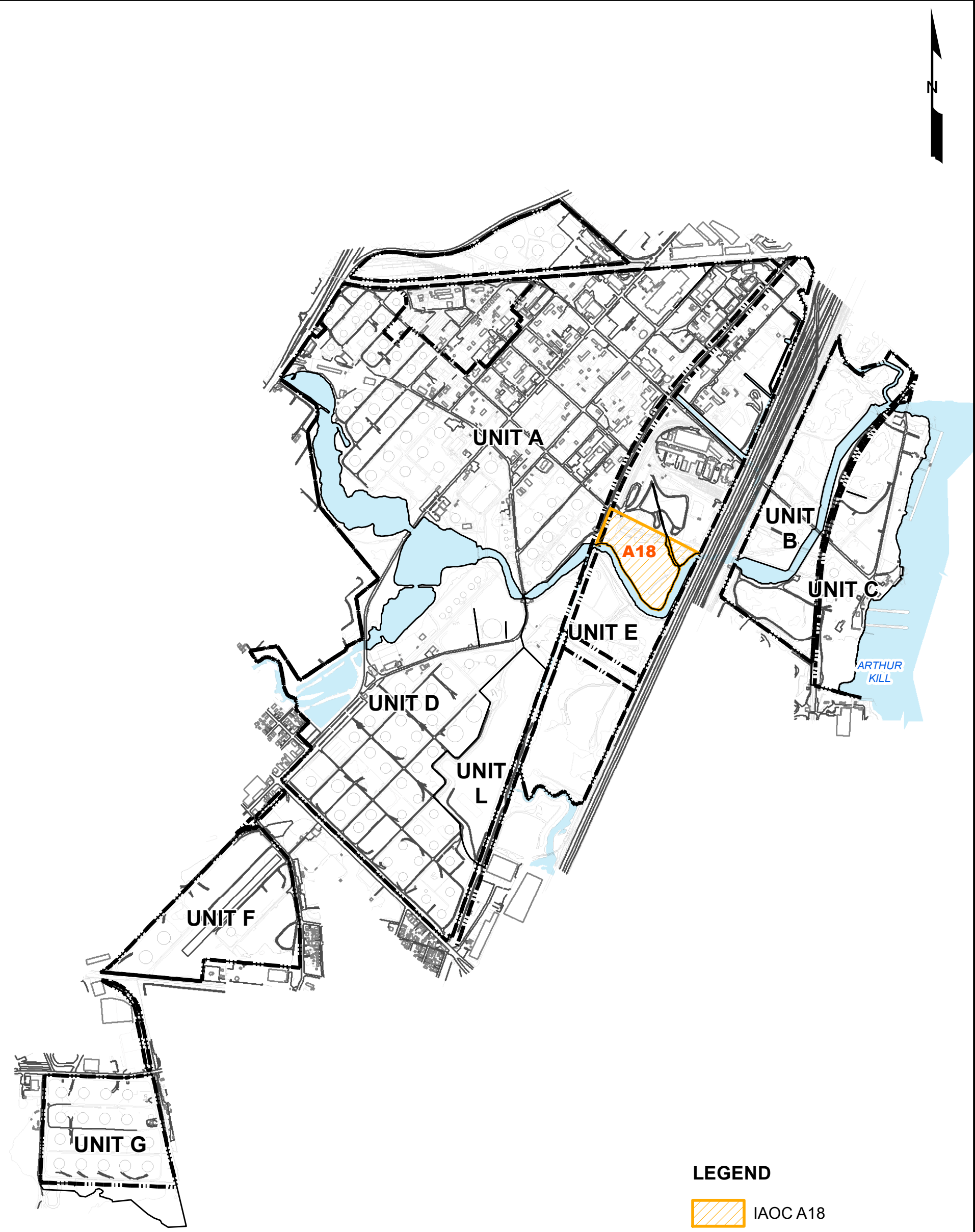


## FIGURES






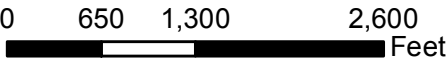
\\azgisstor01\GIS\_P\Projects\ExxonMobil\NJ\_Bayway\GIS\Bayway\_MXD\A18\_Pitch\FSR\EMES\_F1\_A18\_SITELOCATION.mxd

\\azg\gis\stop01\GIS\_Projects\Client\ExxonMobil\NJ\_Bayway\GIS\Bayway\_MXD\A18\_Pitch\FSR\EMES\_F2\_A18\_PROPERTY.mxd.mxd



LEGEND

-  IAOC A18
-  BAYWAY REFINERY COMPLEX PROPERTY BOUNDARY
-  INVESTIGATIVE AREA OF CONCERN



The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



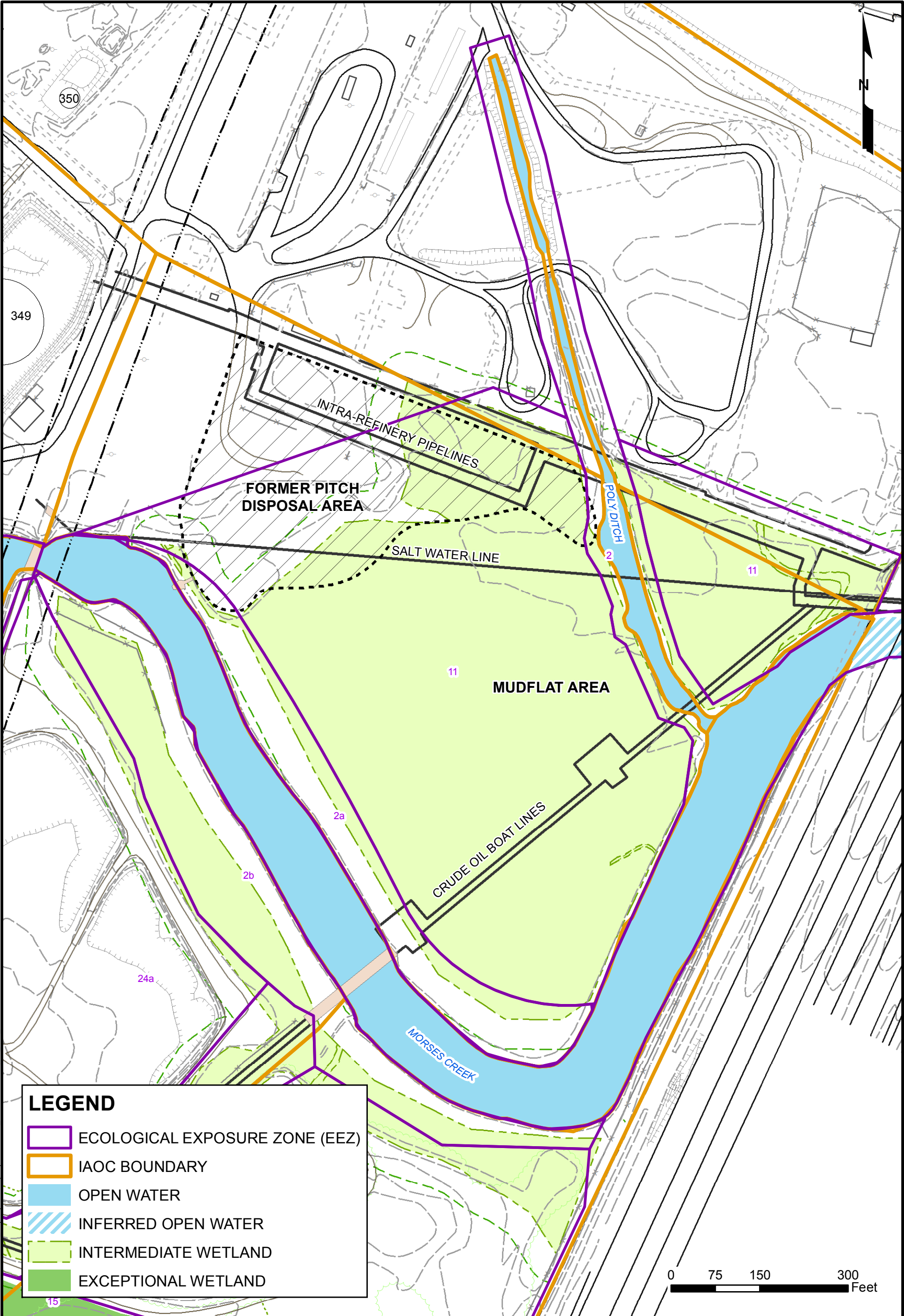
www.kleinfelder.com

PROJECT NO.	20183142
DRAWN:	6/29/2018
DRAWN BY:	A. LEONARD
CHECKED BY:	J. FERRARA
FILE NAME:	EMES_F2_A18_PROPERTY.mxd

<b>PROPERTY MAP</b> <b>IAOC A18</b>	<b>2</b>
BAYWAY REFINERY COMPLEX LINDEN, NEW JERSEY	

FIGURE





\\azqrjst0p01\GIS\Projects\Client\ExxonMobil\NJ Bayway\GIS\Bayway\MXDs\A18 Pitch\FSE\EMES\_F3\_A18 AREA.mxd

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



www.kleinfelder.com

PROJECT NO.	20183142
DRAWN:	6/29/2018
DRAWN BY:	A. LEONARD
CHECKED BY:	J. FERRARA
FILE NAME:	EMES_F3_A18_AREA.mxd

**PROJECT MAP  
IAOC A18**

BAYWAY REFINERY COMPLEX  
LINDEN, NEW JERSEY

FIGURE

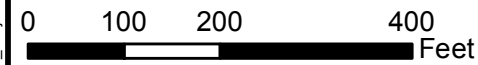
**3**





AERIAL IMAGE WAS AQUIRED ON 3/29/2016

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



**EXPLANATION**

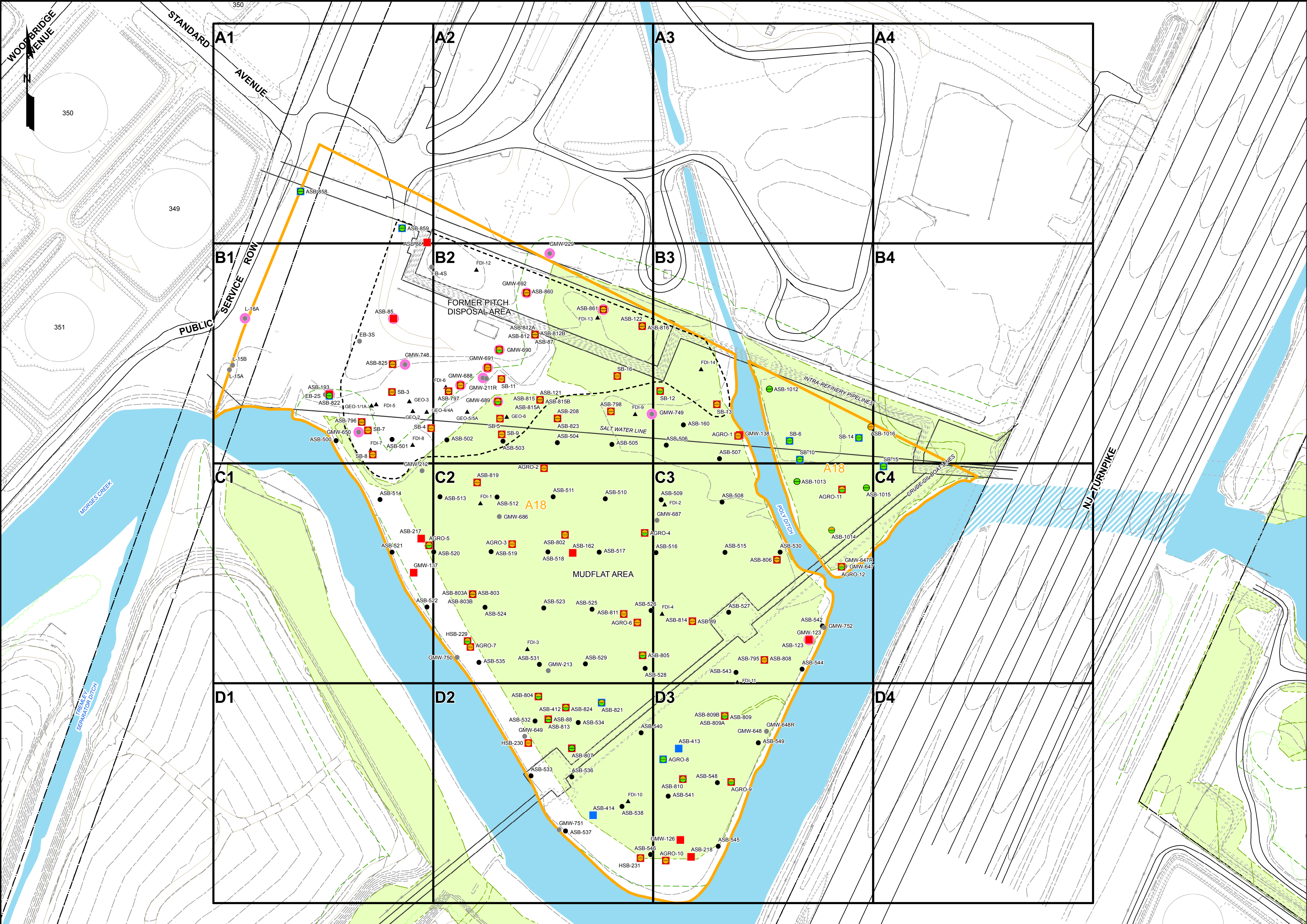
 IAOC AND DESIGNATION

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



PROJECT NO.	20183142	<b>2016 AERIAL PHOTOGRAPH IAOC A18</b>	<b>FIGURE 4</b>
DRAWN:	6/29/2018		
DRAWN BY:	A. LEONARD		
CHECKED BY:	J. FERRARA	BAYWAY REFINERY COMPLEX LINDEN, NEW JERSEY	
FILE NAME:	EMES_F4_A18_AERIAL.mxd		





**LEGEND**

- PREVIOUS SOIL BORING LOCATION, TEMPORARY WELL OR EXISTING MONITORING WELL - NOT SAMPLED FOR PARAMETER SHOWN
- OVERBURDEN MONITORING WELL
- ▭ IAOC BOUNDARY
- ▭ FORMER PITCH DISPOSAL AREA BOUNDARY
- UTILITY POLE
- TANK LOCATION AND DESIGNATION
- FENCE
- ABOVEGROUND PIPING
- CRUDE OIL BOAT LINES, INTRA-REFINERY PIPELINES AND SALT WATER LINE
- PROPERTY BOUNDARY
- OPEN WATER (SEE NOTE 6)
- INFERRED OPEN WATER
- WETLAND TRANSITION (INTERMEDIATE)
- ORDINARY AND INTERMEDIATE RESOURCE WETLANDS (SEE REFERENCE 1 & 4)
- HISTORICAL LNAPL DETECTION
- ▲ GEOTECHNICAL BORING

**TOP HALF = NJDEP CATEGORY 2 DEFAULT PRODUCT LIMIT (8,000 MG/KG)**

**BOTTOM HALF = EPH PRODUCT CEILING LIMIT (30,000 MG/KG)**

● EXCEEDANCE

● NJDEP CATEGORY 2 DEFAULT PRODUCT LIMIT EXCEEDANCE

● NO EXCEEDANCE

**NJDEP TPH PRODUCT CRITERION (10,000 MG/KG)**

■ EXCEEDANCE

■ NO EXCEEDANCE

**NOTES:**

1. SOIL ANALYTICAL DATA POSTED ONLY FOR ANALYTES THAT EXCEED THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION (NJDEP) SOIL REMEDIATION STANDARD AND SCREENING LEVELS.

2. IN ACCORDANCE WITH THE NJDEP SRP GUIDANCE, THE IMPACT TO GROUND WATER PATHWAY IN SOIL ONLY PERTAINS TO THE UNSATURATED ZONE. IMPACT TO GROUND WATER SOILS SCREENING LEVELS DO NOT APPLY AS ALL SAMPLES ARE WITHIN THE SATURATED ZONE IN IAOC A18.

3. WATER BODY LIMITS ARE TIDALLY INFLUENCED AND SUBJECT TO VARIATION. ALSO, WETLANDS OUTSIDE OF SOME PROPERTY BOUNDARIES WERE NOT ACCESSIBLE AND NOT DEFINED.

4. SLIGHT ADJUSTMENTS WERE MADE TO IAOC BOUNDARIES TO REFLECT TAX MAPS, METES AND BOUNDS DESCRIPTION OF THE PROPERTY, AND MORE ACCURATELY MIRRORED GEOREFERENCED INFORMATION.

5. IAOC BOUNDARY DESIGNATION LINES ABUTTING THE PROPERTY BOUNDARY SHALL BE CONSIDERED SYNONYMOUS WITH THE PROPERTY BOUNDARY.

**REFERENCES:**

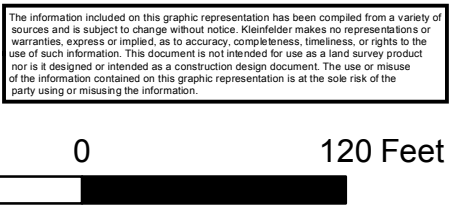
1. MAP, WATER BODY LIMITS, AND LOI WETLANDS BOUNDARY DERIVED FROM FIGURE ENTITLED "WETLAND DELINEATION SURVEY, BAYWAY REFINERY, CITY OF LINDEN, UNION COUNTY, NEW JERSEY", PREPARED BY KELLER & KIRKPATRICK INC., DATED 9-3-15, LAST UPDATED 6-9-16.

2. BASE MAP TOPOGRAPHIC FEATURES TAKEN FROM A MAP PREPARED BY ATLANTIS AERIAL SURVEY CO., INC. FROM PHOTOGRAPHY DATED OCTOBER 3, 2003.

HORIZONTAL DATUM: NAD 83  
VERTICAL DATUM: NGVD 1929  
DISTANCE MEASUREMENTS ARE EXPRESSED IN U.S. FEET.

3. PROPERTY BOUNDARY DERIVED FROM METES AND BOUNDS TAKEN FROM SURVEY, PREPARED BY KELLER & KIRKPATRICK INC., DATED 3-1-93, LAST UPDATED 4-5-93.

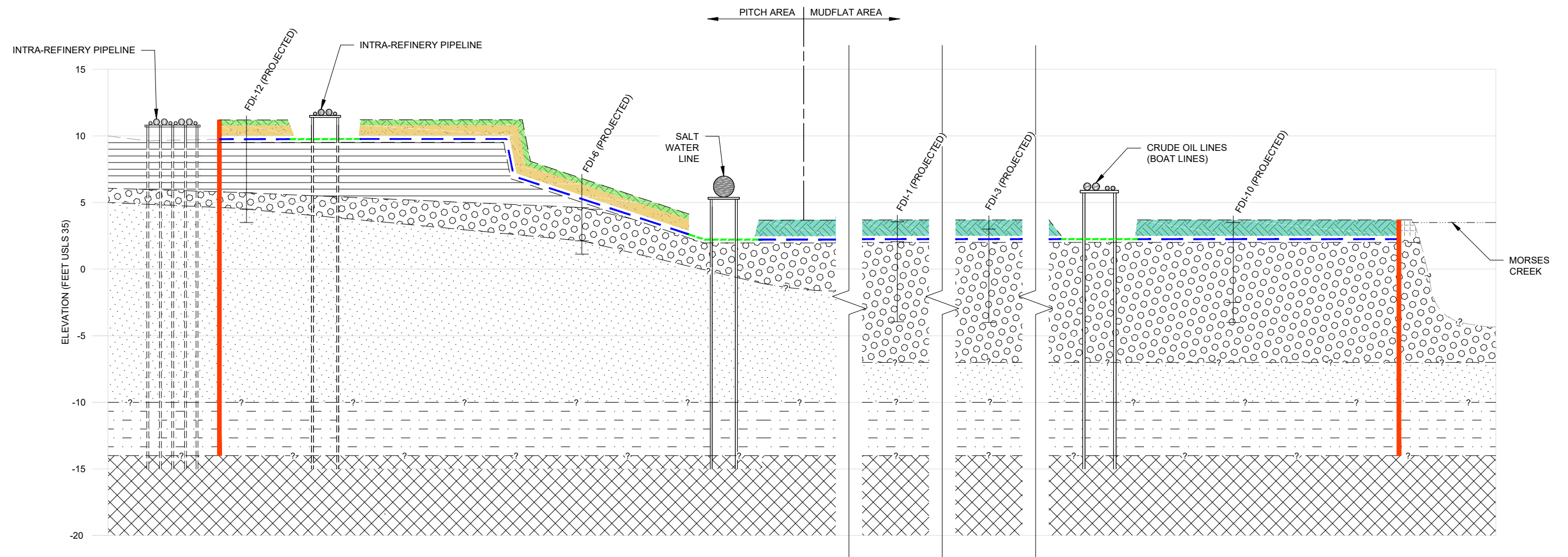
4. LIMITS OF WETLANDS, TRANSITION AREAS, AND STATE OPEN WATERS AS PRESENTED IN THE JULY 2016 LETTER OF INTERPRETATION (LOI) APPROVED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION (NJDEP) DIVISION OF LAND USE REGULATION (DLUR) ON SEPTEMBER 21, 2016. (DLUR FILE NO.: 2009-14-0002-4 FWW 150001).



 <b>KLEINFELDER</b> <i>Bright People. Right Solutions.</i>  www.kleinfelder.com	PROJECT NO.	20203020	<b>SUMMARY OF EPH &amp; TPH EXCEEDANCES IN SOIL</b> <b>NOVEMBER 9, 1993 to NOVEMBER 9, 2016</b> <b>IAOC A18</b>	<b>FIGURE</b>  <b>5</b>
	DRAWN:	3/6/2020		
	DRAWN BY:	S. WILLIAMS		
	CHECKED BY:	D. HUTNICK		
	FILE NAME:	BRC_A18_Soils_EPHTPH.mxd	BAYWAY REFINERY COMPLEX LINDEN, NEW JERSEY	



PROJECTNAME: --  
XREFS: IMAGES: RFSR-892XBL



LEGEND			
	12-INCHES GENERAL BACKFILL		PERMANENT SHEET PILE CONTAINMENT WALL
	6-INCHES TOPSOIL (PITCH AREA)		REACTIVE CAP
	18-INCHES WETLAND MATERIAL (MUDFLAT AREA)		SPRAY-APPLIED MEMBRANE BARRIER
	PITCH		FINAL DESIGN INVESTIGATION
	MUDFLAT		
	MEADOWMAT		
	ALLUVIAL DEPOSITS		
	TILL		
	DECOMPOSED ROCK		

EXXONMOBIL ENVIRONMENTAL SERVICES COMPANY  
LINDEN, NEW JERSEY  
BAYWAY REFINERY COMPLEX

## SHEET PILE WALL WITH REACTIVE CAP PHASE 2



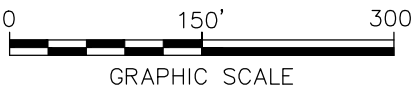


LEGEND

- INVESTIGATIVE AREA OF CONCERN A18 BOUNDARY
- PERIMETER SHEET PILE BARRIER WALL
- PERIMETER JET GROUT BARRIER WALL
- AREA PREVIOUSLY LINED OR CAPPED BY OTHERS - INSTALLATION OF ADDITIONAL CAPPING MATERIALS NOT REQUIRED IN THIS AREA
- UTILITY TO BE PROTECTED
- PROPOSED IMPERMEABLE CAP
- PROPOSED HAUL ROAD

NOTES:

- COORDINATES ARE PROVIDED IN THE NAD83 NEW JERSEY STATE PLANES.
- PITCH AND MUDFLAT AREAS SHALL BE CAPPED USING AN IMPERMEABLE LINER, 18 INCHES OF SOIL, AND WETLAND PLANTINGS INSTALLED ON TOP OF EXISTING PITCH MATERIAL AND MUDFLAT SOILS. LIMITED EXCAVATION SHALL ONLY BE PERFORMED AS NEEDED TO INSTALL CAP MATERIALS.
- AREAS WITHIN 10 FEET OF EXISTING PIPELINES SHALL BE CAPPED USING A SPRAY-APPLIED MEMBRANE BARRIER OR ALTERNATE CAPPING TECHNOLOGY.
- STEEL SHEET PILES SHALL BE INSTALLED ALONG THE POLY DITCH AND THE PERIMETER OF THE LAND SURFACE IN THE IAOC. ALTERNATE CONTAINMENT TECHNOLOGIES (SUCH AS JET GROUTING OR EXTRACTION WELLS) SHALL BE USED FOR PERIMETER CONTAINMENT FOR AREAS WITHIN 10 FEET OF EXISTING PIPELINES.



EXXONMOBIL ENVIRONMENTAL SERVICES COMPANY  
LINDEN, NEW JERSEY  
BAYWAY REFINERY COMPLEX

**SHEET PILE WALL CONTAINMENT  
WITH IMPERMEABLE CAP -  
EXISTING CONDITIONS PLAN**

**ARCADIS** Design & Consultancy  
for natural and built assets

FIGURE  
**7**

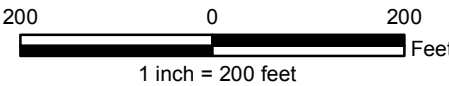


\\azqrjsstor01\GIS Projects\Client\ExxonMobil\NJ BRC\MXD\A18\2020 TIReport\BRC A18 PhotoRef.mxd



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.



**LEGEND**



PHOTOGRAPH LOCATION  
& ORIENTATION \*



IAOC BOUNDARY

\* Photograph exhibit locations  
and orientations not shown for:  
#4 (Aerial Photograph)  
#14 (No. 1 Dam)



PROJECT NO.	20202960
DRAWN:	5/12/2020
DRAWN BY:	S. WILLIAMS
CHECKED BY:	D. HUTNICK
FILE NAME:	BRC_A18_PhotoRef.mxd

**TECHNICAL IMPRACTICABILITY  
PHOTOGRAPH LOCATIONS  
IAOC 18**

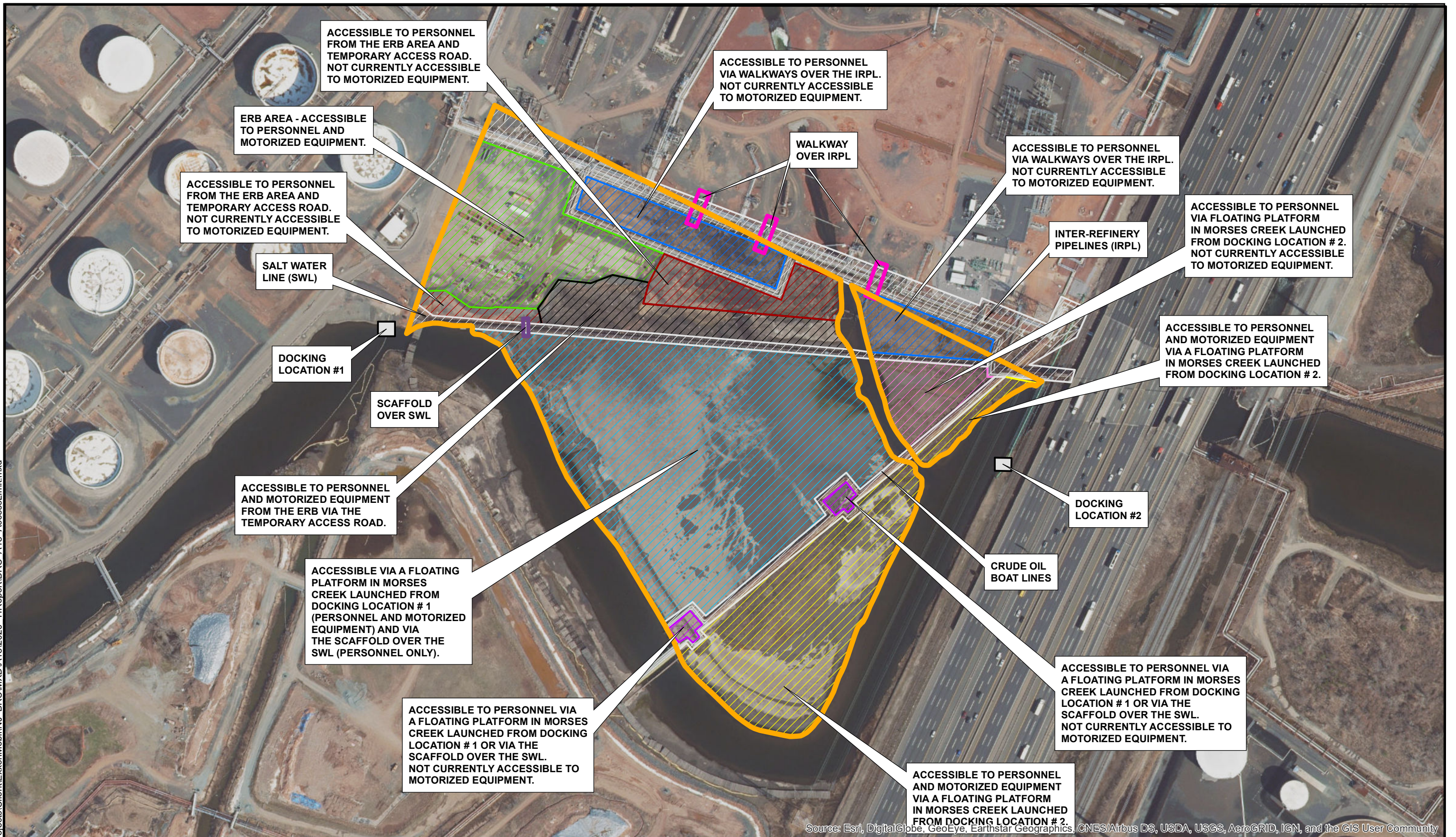
BAYWAY REFINERY COMPLEX  
LINDEN, NEW JERSEY

FIGURE

**8**



\\azqrjsstor01\GIS Projects\Client\ExxonMobil\NJ BRC\MXD\A18\2020 TIReport\BRC A18 AccessLimit.mxd



The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

## LEGEND

 IAOC BOUNDARY

200 0 200  
1 inch = 200 feet



PROJECT NO.	20202960
DRAWN:	5/14/2020
DRAWN BY:	S. WILLIAMS
CHECKED BY:	D. HUTNICK
FILE NAME:	BRC_A18_AccessLimit.mxd

## ACCESSIBILITY LIMITATIONS IAOC 18

BAYWAY REFINERY COMPLEX  
LINDEN, NEW JERSEY

FIGURE

9



## **APPENDIX A**

### **NJDEP Correspondence**

- **NJDEP comments on the Revised Feasibility Study Report dated April 30, 2019.**
- **Summary of the June 18, 2019 meeting between representatives of ExxonMobil, Phillips 66, the LSRP, Arcadis, Kleinfelder and the NJDEP SRP and BEERA dated July 25, 2019.**
- **Electronic correspondence from the NJDEP Case Manager in response to the July 25, 2019 submittal, dated August 14, 2019.**
- **Response to the NJDEP's April 30, 2019 comments on the RFSR dated August 15, 2019.**

**NJDEP comments on the Revised Feasibility Study Report dated April 30, 2019.**





## State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION  
Bureau of Case Management  
Mail Code 401-05F  
P.O. Box 420  
Trenton, New Jersey 08625-0420  
Telephone: 609-633-1455

PHILIP D. MURPHY  
*Governor*

SHEILA Y. OLIVER  
*Lt. Governor*

CATHERINE R. McCABE  
*Commissioner*

April 30, 2019

Maureen Forlenza  
ExxonMobil Environmental and Property Solutions Company  
1400 Park Ave., Building 7  
Linden, NJ 07036

RE: Bayway Refinery – Revised Feasibility Study Report, IAOC A18 Pitch Area, dated  
August 31, 2018  
1400 Park Ave.  
Linden, Union  
PI #: 008282  
Activity Number: RPC000002

Dear Ms. Maureen Forlenza:

The New Jersey Department of Environmental Protection (Department) has completed a review of the Revised Feasibility Study Report (RFSR) for Investigative Area of Concern (IAOC) A18 Pitch Area dated August 31, 2018, submitted pursuant to the Administrative Consent Order (ACO), the Site Remediation Reform Act (N.J.S.A.58:10C-1 et seq.), the Administrative Requirements for the Remediation of Contaminated Sites (N.J.A.C. 7:26C), and the Technical Requirements for Site Remediation at N.J.A.C. 7:26E.

The Department has completed its review of your submittal and identified the following comments:

### General Comments

1. Section 4.3 Recommended Remedial Alternative for IAOC A18 (page 67) states, "...perimeter sheet pile wall installation and impermeable cap installation is the recommended remedial alternative for IAOC A18." The Department does not concur with the recommended alternative. This alternative is not protective of the environment, leaving behind extremely elevated levels of contaminants on the site, eliminating the resource and violating the "no net fill" policy.
2. The recommended remedial alternative of perimeter sheet pile wall installation and impermeable cap installation will cover several acres of wetlands and transition areas. The only proposed remedy for this loss of wetlands is to perform a wetland vegetation pilot study. Contingency plans, such as wetlands creation and/or wetlands banking should

be included in this report or an addendum to account for the possibility of failure of the pilot studies.

3. Please submit all the previous data for the site. The figures submitted only displayed 2015 through 2016 data. Please revise the figures to display all sampling data collected on this IAOC.
4. No cost analysis has been submitted for any of the alternatives. Please include a cost analysis for each alternative.
5. Section 1.1 Purpose and Scope, second paragraph (page 6) states, "The portion of IAOC A18 east of the Poly Ditch is constrained by the Poly Ditch, Moses Creek, the Salt Water Line (SWL), and Boat Lines (Figure 3). This area was not investigated previously, as it was thought to not be impacted due to:
  - a. The presence of the Poly Ditch prior to 1940 (as shown in historical aerial photographs); and
  - b. Construction of the pipelines and initiation of disposal practices of the Pitch Material in the 1940s (Geraghty & Miller 1993)."

The Poly Ditch is part of a different IAOC and needs to be investigated with the rest of the Environmentally Sensitive Natural Resources (ESNRs) in its assigned IAOC. The statements above do not provide sufficient information indicating the Poly Ditch has not been impacted by the site's operations. Investigating this area is the only way to reduce uncertainty. This statement will need to be redacted or eliminated from the report, because it is not part of this IAOC.

### **Specific Comments**

6. For the human exposure and wetlands transition areas, the Department acknowledges that multiple infrastructure appurtenances will impede the remediation of EPH free product and residual product at some locations. However, for those areas that are not impeded by infrastructure appurtenances, further evaluation is necessary to treat or remove EPH free product and residual product pursuant to N.J.A.C. 7:26E-5.1(e). Containment such as Capping and Perimeter Containment should be considered only where removal or treatment are not practicable. The Department recommends that ExxonMobil consider the removal and treatment options where removal and treatment are practicable, and that ExxonMobil differentiate these areas from the areas impeded by infrastructure appurtenances.
7. ExxonMobil should develop a comprehensive map of historical TPH and EPH soil and sediment data for IAOC A18 including the vertical extents of TPH greater than 10,000 mg/kg and EPH greater than 17,000 mg/kg. ExxonMobil should include information from the geotechnical soil borings logs (Appendix F) because the logs identify the presence of pitch, and from the descriptions in the boring logs of Appendix B (e.g., "residual oil" at a depth of 11 to 12 feet in ASB-861, "PITCH MATERIAL" in GMW-686, etc.). The locations of Historical LNAPL locations (Figure 7) should also be included and identified on the comprehensive TPH/EPH map. The infrastructure

appurtenances and sizes are not identical on all figures (e.g., Figure 5D versus Figure 12). ExxonMobil should include all infrastructure appurtenances and standardize the horizontal dimensions to be consistent between maps, especially maps where remediation evaluations are included.

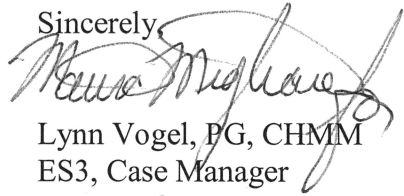
8. The Department specifies that 30,000 mg/kg is the ceiling concentration for Capping activities for soil (maximum ceiling number in the EPH calculator, when using the grain size). The elevated levels above 30,000 mg/kg EPH shall be removed to comply with N.J.A.C. 7:26E-5.1(e). The removal of high concentration of free product was not evaluated in the report. If it is not practicable, a technical impracticability report shall be submitted as indicated in the Protocol for Addressing Extractable Petroleum Hydrocarbon guidance document.
9. Please provide a full vertical and horizontal delineation of the pitch material where EPH elevations are greater than 30,000 mg/kg.
10. Section 3.1.4 Potential Vapor Generation Evaluation discusses an evaluation of background VOC concentrations in the former Pitch Area. An air sample was taken in December 2015 and total VOCs and benzene were detected; these results were considered representative of background conditions in the Pitch Area. A more current air sample should be collected to appropriately represent background conditions under current conditions.

It is proposed to use the results of the potential vapor generation evaluation along with exposure limits set by OSHA to develop vapor mitigation levels for future intrusive activities. However, many of OSHA's PELs are outdated and inadequate for ensuring protection of worker health because most of OSHA's PELs were issued shortly after adoption of the Occupational Safety and Health Act in 1970 and have not been updated since that time. OSHA recommends that employers consider using alternative occupational exposure limits because the Agency believes that exposures above some of these alternative occupational exposure limits may be hazardous to workers, even when the exposure levels are in compliance with the relevant PELs. It may be more appropriate to use NJDEP Vapor Intrusion Screening Levels to develop mitigation levels. The development of these mitigation levels should be discussed jointly with USEPA and the Department.

Please submit an Addendum to the Revised Feasibility Study Report, IAOC A18 Pitch Area and a Technical Impracticability report within 90 days from the date of this correspondence.

Thank you for your cooperation in this matter. If you have any questions, call Charles Zielinski at (609)292-0848, or email at [Charles.Zielinski@dep.nj.gov](mailto:Charles.Zielinski@dep.nj.gov).

Sincerely,

A handwritten signature in dark ink, appearing to read "Lynn Vogel", written over the word "Sincerely,".

Lynn Vogel, PG, CHMM  
ES3, Case Manager  
Bureau of Case Management

cc: Charles Zielinski, NJDEP  
Alan Straus, USEPA via electronic mail  
Gina Ferreira, USEPA via electronic mail  
Iman Olguin-Lira, NJDEP via electronic mail  
John Ruhl, NJDEP via electronic mail  
Allan Motter, NJDEP via electronic mail  
Deborah LaMond, Phillips 66 via electronic mail  
Michael Renzulli, LSRP via electronic mail  
Paul Lucuski, Kleinfelder via electronic mail

**Summary of the June 18, 2019 meeting between representatives of ExxonMobil, Phillips 66, the LSRP, Arcadis, Kleinfelder and the NJDEP SRP and BEERA dated July 25, 2019.**



**SENT VIA ELECTRONIC MAIL**

July 25, 2019

Mr. Charles E. Zielinski  
State of New Jersey  
Department of Environmental Protection  
Site Remediation Program  
Bureau of Case Management  
Mail Code 401-05F  
PO Box 420  
Trenton, NJ 08625-0420

**Re: June 18, 2019 Meeting Notes**

**Project Overview, Status Update and  
Response to NJDEP's Comments on the *Revised Feasibility Study Report***

Bayway Refinery Complex  
Park Avenue and Brunswick Avenue  
Block 520, Lot 6  
City of Linden, Union County, New Jersey  
NJDEP SRP Program Interest (PI) No.: 008282  
NJDEP DLUR File No.: 2009-04-0001.1 FWW 150001 FWW 140001

Dear Mr. Zielinski:

Thank you very much for coordinating a meeting with representatives of ExxonMobil Environmental and Property Solutions (ExxonMobil), Phillips 66 (P66), the Licensed Site Remediation Professional (LSRP), Preferred Design Consultant – Arcadis (PDC), Kleinfelder, Inc. (Kleinfelder) and the New Jersey Department of Environmental Protection (NJDEP) on June 18, 2019. The objective of the meeting was to provide a project overview and status update and review the NJDEP's comments on the *Revised Feasibility Study Report* (RFSR) for Investigative Area of Concern (IAOC) A18 (Pitch Area) at the Bayway Refinery Complex (BRC) in Linden, New Jersey.

Below is a brief summary of our meeting. If this summary does not agree with your notes, please advise in writing.

The June 18, 2019 meeting was attended by the participants listed below:

**NJDEP**

- Charles Zielinski – Site Remediation Program (SRP), Case Manager
- Allan Motter – Bureau of Environmental Evaluation and Risk Assessment (BEERA), Supervisor
- John Ruhl – BEERA, Technical Coordinator
- Iman Olguin-Lira – BEERA, Ecological Risk Assessor (via telephone)

## **ExxonMobil, P66 and ExxonMobil's Consultants**

- Maureen Forlenza – ExxonMobil
- Michael Renzulli – LSRP
- Deborah LaMond – P66
- Corey Averill – Arcadis
- Michael Meyerhoefer – Kleinfelder
- Justin Moses – Kleinfelder
- David Hutnick – Kleinfelder
- Paul Lucuski – Kleinfelder

## **Project Overview**

Kleinfelder provided an overview of IAOC A18, its location within the BRC and challenges to investigation and remediation efforts within this IAOC.

## ***IAOC A18 Description***

Kleinfelder provided an overview of IAOC A18 including details of the following areas and key refinery infrastructure:

- Former Pitch Disposal Area
- Mudflat Area
- Peninsula Area
- Morses Creek
- Poly Ditch
- Former East Retention Basin ([ERB], also referred to as the East Separator)
- Heat Exchanger Cleaning (HEC) pad
- Salt Water Line (SWL)
- Crude Oil Boat Lines
- Out-of-service Inter-Refinery Pipeline (IRPL) and multiple intra-refinery pipelines

Details of these areas and site features are included in the August 31, 2018 *Revised Feasibility Study Report* (RFSR).

## ***Accessibility and Constructability Challenges***

Kleinfelder noted several challenges to accessibility and constructability related to refinery infrastructure and site conditions which impact investigation and remediation activities as noted below.

- Active refinery infrastructure
  - SWL – The SWL is a 60-inch diameter bell-and-spigot cast iron pipeline that was constructed in approximately 1955. The SWL is supported on timber piles, some of which have been reinforced with concrete pile caps. The SWL is located in the northern portion of IAOC A18 and extends from east to west through the Former Pitch Disposal Area, the Mudflat Area and the Peninsula east of the Poly Ditch. Personnel can access the area to the south of the SWL via a scaffold that crosses over the line. Motorized equipment cannot access the area to the south of the SWL from the north. Currently, light-weight motorized equipment can access the



area to the south of the SWL via a barge in Morses Creek. On the peninsula east of the Poly Ditch, personnel can access the area to the north of the SWL via elevated walkways constructed over the IRPL at the northern boundary of IAOC A18. Personnel must access the area on the peninsula east of the Poly Ditch south of the SWL via a boat launched from the eastern side of Morses Creek adjacent to the New Jersey Turnpike.

In addition to the access challenge presented by the SWL, ground-intrusive work in the vicinity of the SWL is limited by several factors.

- Based on modeling performed by Kleinfelder, an unsupported 8-foot deep excavation near the SWL is not feasible due to potential slope instability. The wooden piles are sensitive to lateral displacements and displacements as small as 1 inch may result in overstressing of the piles, which could result in failure of the SWL.
- Construction activities such as sheet pile installation or operation of construction equipment near the SWL can generate vibration which can potentially affect the timber piles. Vibration monitoring has been conducted via seismographs installed along the alignment of the SWL throughout Pilot Program activities (details of the Pilot Program are included in a later section). Thresholds specified in the SWL Monitoring Plan for the Pilot Program have not been exceeded during construction activities, but seismic monitoring will be required for future construction activities near the SWL. Exceedances of the thresholds may require work to be stopped and/or additional controls implemented.
- P66 has previously required a 40-foot buffer around the SWL (20 feet on either side of the SWL). Excavation activities are currently prohibited within this buffer area.

The SWL is a critical piece of refinery infrastructure and operations. A breach in this line would not only result in a disruption to refinery operations but would also likely result in loss of life for workers in this area. Protecting the SWL, in some instances by avoiding work in the area, is a top priority.

- Crude Oil Boat Lines – Two 30-inch diameter and two 24-inch diameter steel pipelines that transfer crude oil between the Waterfront Area to the east of IAOC A18 and the Tremley Tank Field which is located to the southwest of IAOC A18. The Crude Oil Boat Lines are supported on timber piles and are elevated approximately 3 to 5 feet above ground surface. The Crude Oil Boat Lines extend northeast to southwest across the Mudflat Area and Peninsula east of the Poly Ditch. Personnel can access the area to the southeast of the Crude Oil Boat Lines by crossing the scaffold over the SWL and walking under the Crude Oil Boat Lines. Motorized equipment cannot access the area to the southeast of the Crude Oil Boat Lines from the northeast. Currently, light-weight motorized equipment can access the area to the southeast of the Crude Oil Boat Lines via a barge in Morses Creek. Access to the peninsula east of the Poly Ditch is described above in the SWL section.

Like the SWL, P66 has required a 40-foot buffer around the Crude Oil Boat Lines

(20 feet on either side of the Crude Oil Boat Lines). Excavation activities are currently prohibited within this buffer area.

To date, vibration monitoring has not been conducted on the Crude Oil Boat Lines because vibration-generating construction activities have not been conducted in proximity to these lines. Baseline vibration monitoring and monitoring during construction activities will be conducted at a later date. The Crude Oil Boat Lines are critical refinery infrastructure. A breach in the lines would result in a disruption to refinery operations, a release to the environment and potential injury or loss of life for workers in this area. Every effort is being made to ensure that the Crude Oil Boat Lines are protected during investigation and remediation activities.

- The intra-refinery pipelines are located on metal pipe racks extending northwest to southeast at the northern boundary of IAOC A18, adjacent to the butane/propane caverns area (IAOC A17). The active pipelines carry various liquids and gases throughout the production units in the BRC. Pitch material has been observed beneath the intra-refinery pipelines and within the rectangular area formed by the various pipelines. Access to this rectangular area is restricted by the pipelines. Personnel can access this area via elevated walkways from the butane/propane caverns area (IAOC A17) to the north, but motorized equipment cannot access this area.

Like the SWL and Crude Oil Boat Lines, P66 has required a 40-foot buffer around the IRPL (20 feet on either side). Excavation activities are currently prohibited within this buffer area.

To date, vibration monitoring has not been conducted on the IRPL because vibration-generating construction activities have not been conducted in proximity to these lines. Baseline vibration monitoring and monitoring during construction activities will be conducted at a later date. The IRPL is a key piece of refinery infrastructure. A breach in the lines would potentially result in a disruption to refinery operations, a release to the environment and potentially injury or loss of life for workers in this area. Every effort is being made to ensure that the IRPL is protected during investigation and remediation activities.

- Site conditions

- Morses Creek is a tidal water body from No. 1 Dam to the confluence with the Arthur Kill. No. 1 Dam is the head of tide for the BRC. Upstream of No. 1 Dam including adjacent to IAOC A18, Morses Creek is tidally influenced, but is not considered a tidal water body. As the tidal elevation rises, surface water discharge from Morses Creek at No. 1 Dam is restricted influencing the surface water elevation of Morses Creek. Surface water inundates the Mudflat Area surface twice a day during half of the lunar cycle during the periods of restricted surface water flow. The approximate high-water line and photographs of the Mudflat Area during periods of surface water inundation were shown during the meeting. The maximum surface water depth observed in the Mudflat Area is approximately 16 inches.

- The portions of the Former Pitch Disposal Area and Mudflat Area north of the SWL are currently accessible to equipment such as drill rigs and excavators via the temporary access road that has been constructed for the ongoing Pilot Program activities. Prior to construction of this road, there was limited means of accessing these areas with motorized equipment due to the soft surface materials and highly compressible subsurface. Limited equipment operations have been conducted in the Mudflat Area south of the SWL as access to this area must be obtained via a barge in Morses Creek.
- Both the Former Pitch Disposal Area and Mudflat Area are underlain by a meadow mat layer which is highly compressible and unable to support most motorized equipment such as drill rigs. The Pitch material is a relatively soft asphalt-like material that becomes softer during the warmer months of the year. Pitch material is less compressible than the meadow mat layer and is generally displaced outward rather than compressing when a load is applied to the surface. Additionally, Mudflat Area soils are soft and have typically not been able to support motorized equipment without structural support elements such as swamp mats, even during periods of the lunar cycle when the Mudflat surface is not inundated with surface water. Based on equipment trials during the Pilot Program, the largest equipment that can be supported on the Mudflat Area with swamp mats is approximately 6,000 to 8,000 pounds.

### **Previous Meetings with the NJDEP and Previous Regulatory Submittals**

A timeline of previous meetings between the NJDEP, ExxonMobil, the LSRP and ExxonMobil's consultants, as well as regulatory submittals and approvals for IAOC A18 was presented. These include:

- 05/04/2014 – Supplemental Site-Wide Remedial Investigation Report (SSWRIR) Submittal
- 07/24/2014 – FSR Submittal
- 01/29/2015 – PDI Workplan Submittal
- 07/27/2015 – PDI Workplan Approval
- 09/21/2015 – SSWRIR Approval
- 04/22/2016 – Supplemental PDI Workplan Submittal via in-person meeting with the NJDEP
- 04/26/2016 – Supplemental PDI Workplan Approval
- 10/25/2017 – Supplemental PDI Summary Meeting
- 01/24/2018 – Pre-Application Meeting w/ NJDEP Division of Land Use Regulation (DLUR)
- 03/23/2018 – Remediation Strategy Road Map, Rev. 5 Submittal
- 08/31/2018 – RFSR Submittal
- 12/10/2018 – Remediation Strategy Road Map, Rev. 5 Approval
- 04/30/2019 – NJDEP's comments on RFSR
- 06/18/2019 – Meeting to review NJDEP's comments on RFSR

A copy of the minutes from the January 24, 2018 Pre-application meeting with the NJDEP DLUR is available as **Attachment 1**.

## **RFSR Overview**

A review of the key points of the August 31, 2018 RFSR was presented. These key points include:

- Regulatory background of IAOC A18
  - The regulatory background of the BRC and IAOC A18 were presented in the RFSR, but not reviewed during the meeting.
- PDI and supplemental PDI activities and results
  - Results of the PDI and supplemental PDI activities were presented in the RFSR, but not reviewed during the meeting.
- Remedial alternatives analysis
  - Details of the remedial alternatives analysis were presented in the RFSR, but not reviewed during the meeting.
- Proposed remedial actions for IAOC A18
  - A perimeter barrier wall for hydraulic containment;
  - An impermeable cap to prevent direct contact to impacted material; and
  - Potential limited excavation to facilitate installation of the perimeter barrier wall and impermeable cap.
- Description of remedial design data gaps identified in RFSR remedial alternatives analysis
  - These design data gaps are to be addressed prior to the preparation of a Remedial Action Workplan (RAW) and Conceptual Design.
- Pilot Program developed to address remedial design data gaps
  - The construction phase of the Pilot Program is currently ongoing and should be concluded in the next 6 to 8 weeks.
  - The monitoring phase of the Pilot Program will continue into 2020.

## **Review of NJDEP's Comments on the RFSR and ExxonMobil's Preliminary Responses**

Each of the NJDEP's comments on the August 31, 2018 RFSR were reviewed. ExxonMobil's preliminary responses to the comments were presented and discussed with the meeting attendees. A formal response to comment letter will be submitted to NJDEP by August 15, 2019. Below is a summary of the comments, preliminary responses and discussions.

ExxonMobil and LSRP indicated that the NJDEP's comments were unexpected based on previous engagement with NJDEP on this IAOC.

- **NJDEP Comment # 1** – *Section 4.3 Recommended Remedial Alternative of IAOC A18 states, '...perimeter sheet pile wall installation and impermeable cap installation is the recommended alternative for IAOC A18'. This alternative is not protective of the environment, leaving behind extremely elevated levels of contaminants on the site, eliminating the resource and violating the "no net fill" policy.*
  - **ExxonMobil's response** - The proposed remedial action is protective of the environment, using a containment approach consistent with the NJDEP-approved Remediation Strategy Road Map. The feasibility of enhancing the resource to improve the function and value of the wetland is being evaluated through an on-going pilot program. The NJDEP DLUR indicated during a permit pre-application meeting on January 24, 2018 that a net fill of the Mudflat Area with a hardship exception could be considered. A key design parameter of sustainable vegetative growth is elevation. A key component of the pilot program is to establish the optimal elevation for wetland vegetative growth. Floodway modeling of the Poly Ditch and

Morses Creek is ongoing to understand the flood impacts related to fill within the Mudflat Area.

- **Follow-up discussion** – Iman Olguin-Lira commented that she was concerned about changing the Mudflat Area from a wetland to an upland area by placing up to 2 feet of fill material on the ground surface. Kleinfelder clarified that the placement of 2 feet of fill material is not expected to result in an elevation change of 2 feet. Because the subsurface materials are highly compressible, the addition of fill material will result in an elevation change less than the thickness of the fill material placed. The potential compression/consolidation was modeled during the PDI activities and is currently being measured and evaluated as part of the Pilot Program. Kleinfelder also discussed the January 24, 2018 pre-application meeting with the NJDEP DLUR in which representatives of the NJDEP DLUR stated that evaluating the potential for wetland construction or enhancement during the Pilot Program would be acceptable. Lastly, it was noted that determining the least amount of fill material required for sustaining vegetation is a key objective of the pilot program.
- **NJDEP Comment # 2** – *The recommended remedial alternative of perimeter sheet pile wall installation and impermeable cap installation will cover several acres of wetlands and transition areas. The only proposed remedy for this loss of wetlands is to perform a wetland vegetation pilot study. Contingency plans, such as wetlands creation and/or wetlands banking should be included in this report or an addendum to account for the possibility of failure of the pilot studies.*
  - **ExxonMobil's response** - The wetland vegetation pilot study is ongoing to address data gaps for enhancing the Mudflat Area as a vegetated wetland. Wetlands creation at an alternative location and/or wetlands banking would be included in a future regulatory deliverable (2H2020) if the results of the pilot study indicate that enhancement of the Mudflat Area as a vegetated wetland is not viable or a NJDEP DLUR hardship exception for fill within the floodway cannot be obtained.
  - **Follow-up Discussion** – Iman Olguin-Lira asked if ExxonMobil is aware of a wetland mitigation bank parcel of approximately 9 acres that is currently available. ExxonMobil and Kleinfelder stated that the availability of a parcel of a specific size would have to be determined closer to when it would actually be needed as wetland mitigation bank parcels are typically purchased quickly after becoming available. It is unlikely that any 9-acre parcel available at the time of the meeting would be available at the time the remedial actions would be implemented for IAOC A18. The preferred course of action for IAOC A18 is to enhance the function and value of the existing wetland, or to replace it in-kind as part of the remedial action.

Iman followed-up by stating that this comment on the RFSR was made over her concern that the change of elevation in the Mudflat Area would result in this area ceasing to function as a wetland. Kleinfelder stated that the elevation required to support wetland vegetation is currently being evaluated as part of the ongoing Pilot Program, and the intent of the proposed remedial action is not to convert any areas that are currently classified as wetlands to upland areas. Remedial actions that will result in changes to areas currently classified as wetlands are subject to the review and approval of the NJDEP DLUR Mitigation Unit prior to implementation.

- **NJDEP Comment # 3** – *Please submit all the previous data for the site. The figures submitted only displayed 2015 through 2016 data. Please revise the figures to display all sampling data collected on this IAOC.*
  - **ExxonMobil's response** – Historical site data has been submitted to the NJDEP in previous reports, including the FSR. Additional data collected for the site will be presented in a future regulatory deliverable (2H2020).
  - No follow-up discussion
- **NJDEP Comment # 4** – *No cost analysis has been submitted for any of the alternatives. Please include a cost analysis for each alternative.*
  - **ExxonMobil's response** – A cost estimate will be included in a future regulatory deliverable (2H2020).
  - No follow-up discussion.
- **NJDEP Comment # 5** – *Section 1.1 Purpose and Scope, second paragraph states, "The portion of IAOC A18 east of the Poly Ditch is constrained by the Poly Ditch, Morses Creek, the Salt Water Line and Boat Lines. This area was not investigated previously, as it was thought to not be impacted due to:*
  - *The presence of the Poly Ditch prior to 1940 (as shown in historical aerial photographs); and*
  - *Construction of the pipelines and initiation of disposal practices of the Pitch Material in the 1940s (Geraghty & Miller, 1993)."*

*The Poly Ditch is part of a different IAOC and needs to be investigated with the rest of the Environmentally Sensitive Natural Resources (ENSRs) in its assigned IAOC. The statements above do not provide sufficient information indicating the Poly Ditch has not been impacted by the site's operations. Investigating this area is the only way to reduce uncertainty. This statement will need to be redacted or eliminated from the report, because it is not part of this IAOC.*

  - **ExxonMobil's response** – The statement in Section 1.1 pertains to the peninsula to the east of the Poly Ditch, which is included in IAOC A18, but not the Poly Ditch itself, which flows through IAOC A18. The area to the east of the Poly Ditch was first investigated during the PDI activities as presented in the RFSR. Further investigation of the area to the east of the Poly Ditch was conducted during the Pilot Program. Details of the investigation of this area will be included in a future regulatory deliverable (2H2020). The Poly Ditch is included as part of the final Consent Judgment and the remedy for the Poly Ditch will be implemented with the rest of the ENSRs in its assigned IAOC.
  - No follow-up discussion
- **NJDEP Comment # 6** – *For the human exposure and wetlands transition areas, the Department acknowledges that multiple infrastructure appurtenances will impede the remediation of EPH free product and residual product at some locations. However, for those areas that are not impeded by infrastructure appurtenances, further evaluation is necessary to treat or remove EPH free product and residual product pursuant to N.J.A.C.*

7:26E-5.1(e). Containment such as capping and perimeter containment should be considered only where removal or treatment are not practicable. The Department recommends that ExxonMobil consider removal and treatment options where removal and treatment are practicable, and that ExxonMobil differentiate these areas from the areas impeded by infrastructure appurtenances.

- **ExxonMobil's response** – ExxonMobil has considered removal and treatment options where it is technically feasible as presented in the July 2014 FSR. Additionally, the August 2018 RFSR proposed potential limited excavation and offsite disposal of Pitch material and/or Mudflat Area soils as required to:

- Accommodate grading and installation of impermeable capping materials;
- Remove Pitch material that is contacting the SWL to allow installation of impermeable capping materials under the SWL; and
- Maintain required post-construction grades to support the growth of wetland vegetation planted on clean fill placed over the impermeable cap.

The removal areas are identified on figures included in the RFSR. Final areas where removal of Pitch material is proposed will be presented in a future regulatory submittal (2H2020).

- **Follow-up discussion** – Alan Motter stated that technical infeasibility (TI) would need to be demonstrated if ExxonMobil plans to leave areas of free product in-place rather than removing. Kleinfelder asked if a TI discussion can be included as part of the RAW or if it needs to be submitted as a separate document. John Ruhl stated that it could be submitted as part of the RAW, if applicable.

- **NJDEP Comment # 7** – *ExxonMobil should develop a comprehensive map of historical TPH and EPH soil and sediment data for IAOC A18 including the vertical extents of TPH greater than 10,000 mg/kg and EPH greater than 17,000 mg/kg. ExxonMobil should include information from the geotechnical soil boring logs (Appendix F) because the logs identify the presence of pitch, and from the descriptions in the boring logs of Appendix B (e.g., "residual oil" at a depth of 11 to 12 feet in ASB-861, "PITCH MATERIAL" in GMW-686, etc.). The locations of Historical LNAPL locations (Figure 7) should also be included and identified on the comprehensive TPH/EPH map. The infrastructure appurtenances and sized are not identical on all figures (e.g. Figure 5D versus Figure 12). ExxonMobil should include all infrastructure appurtenances and standardize the horizontal dimensions to be consistent between maps, especially maps where remediation evaluations are included.*

- **ExxonMobil's response** - A comprehensive TPH/EPH map will be included in a future regulatory deliverable (2H2020). Future regulatory submittals will also include figures that use standardized horizontal dimensions for various site features.

- No follow-up discussion.

- **NJDEP Comment # 8** - *The Department specifies that 30,000 mg/kg is the ceiling concentration for Capping activities for soil (maximum ceiling number in the EPH calculator, when using the grain size). The elevated levels above 30,000 mg/kg EPH shall be removed to comply with N.J.A.C. 7:26E-5.1(e). The removal of high concentration of free product was not evaluated in the report. If it is not practicable, a technical*



*impracticability report shall be submitted as indicated in the Protocol for Addressing Extractable Petroleum Hydrocarbon guidance document.*

- **ExxonMobil's response** - As shown on figures included in the FSR and RFSR, EPH concentrations exceed 30,000 mg/kg throughout the Former Pitch Disposal Area, Mudflat Area and peninsula area east of the Poly Ditch in IAOC A18. Similar remedial actions have been implemented for separate phase material at other IAOCs at the BRC consistent with the NJDEP approved Remediation Strategy Road Map because these remedial actions are protective of potential receptors and the environment. It is not practicable to remove all soil with EPH concentrations above 30,000 mg/kg due to active refinery infrastructure and other constructability factors. Therefore, a TI analysis will be prepared and included in a future regulatory deliverable (2H2020), if applicable.
- No follow-up discussion.
- **NJDEP Comment # 9** - *Please provide a full vertical and horizontal delineation of the pitch material where EPH elevations are greater than 30,000 mg/kg.*
  - **ExxonMobil's response** - A comprehensive TPH/EPH map will be included in a future regulatory deliverable (2H2020).
  - No follow-up discussion.
- **NJDEP Comment # 10** - *Section 3.1.4 Potential Vapor Generation Evaluation discusses an evaluation of background VOC concentrations in the former Pitch Area. An air sample was taken in December 2015 and total VOCs and benzene were detected; these results were considered representative of background conditions in the Pitch Area. A more current air sample should be collected to appropriately represent background conditions under current conditions.*

*It is proposed to use the results of the potential vapor generation evaluation along with exposure limits set by OSHA to develop vapor mitigation levels for future intrusive activities. However, many of OSHA PELs are outdated and inadequate for ensuring protection of worker health because most of OSHA's PELs were issued shortly after adoption of the Occupational Safety and Health Act in 1970 and have not been updated since that time. OSHA recommends that employers consider using alternative occupational exposure limits because the Agency believes that exposures above some of these alternative occupational exposure limits may be hazardous to workers, even when the exposure limits are in compliance with the relevant PELs. It may be more appropriate to use NJDEP Vapor Intrusion Screening Levels to develop mitigation levels. The development of these mitigation levels should be discussed jointly with USEPA and the Department.*

- **ExxonMobil's response** - Appropriate worker safety action levels will be included in the site-specific Health and Safety Plan and will meet applicable regulations and company standards.
- No follow-up discussion

## **Review of the IAOC A18 Pilot Program Objectives, Scope of Work and Status**

The objectives, scope of work and status of the Pilot Program, which is being conducted to address remedial design data gaps, was presented. The objectives of the Pilot Program are as follows:

- Address remedial design data gaps prior to the preparation of a RAW and Conceptual Design;
- Refine the constructability evaluation included in the RFSR and evaluate site-specific implementation logistics related to:
  - Equipment access;
  - Equipment stability and maneuverability;
  - Soft surface and highly compressible subsurface;
  - Water inundation; and
  - Odor generation/migration;
- Collect data to support regulatory acceptance/approval for the selected remedial actions; and
- Evaluate long-term effectiveness and sustainability of the selected remedy considering P66's ongoing operations.

The various modules of the Pilot Program and their status as of June 18, 2019 were:

- Site Preparation/Mobilization – Complete
- Environmental Monitoring – Complete
- Flood Berm Removal – Complete
- Road Construction and Equipment Accessibility – Complete
- Upland Geotechnical Pilot Study – Complete
- Alternate Perimeter Wall Pilot Study – Complete
- Dewatering/Stabilization Pilot Study – Complete
- SWL Monitoring – In Progress
- Jet Grout Pilot Study – In Progress
- Eastern Peninsula Pilot Study – In Progress
- Upland Hydrogeological Pilot Study – In Progress
- Sunshade Bridge Removal – In Progress
- Edge of Mudflat Geotechnical Pilot Study – In Progress
- Wetland Vegetation Pilot Study – In Progress
- Alternative Cap/Liner Pilot Study – In Progress
- Former Pitch Disposal Area Cap Cell Pilot Study – In Progress
- Mudflat Area Cap Cell Pilot Study – In Progress
- Additional Geotechnical Borings – To be Completed
- Test Pit in Vegetated Area East of Boat Lines – To be Completed
- Center of Mudflat Trench – To be Completed
- Summer Test Pits – To be Completed

## **Project Progression**

The anticipated schedule for future activities and deliverables was presented as follows:

- Written response to NJDEP's comments – 2H2019
- Complete Pilot Program construction activities – 2H2019

- Complete Pilot program monitoring activities – 1H2020
- Remedial Action Work Plan (including 30% design) – 2H2020
- Contractor procurement and permitting – 1H2021
- RA implementation – 2H2021

### **Follow-up Telephone Conversation – June 19, 2019**

On June 19, 2019, Charles Zielinski, the NJDEP SRP Case Manager, contacted Michael Renzulli, LSRP, to discuss the results and actions from the June 18, 2019 meeting. Charles Zielinski indicated that he will be the primary contact for TI consideration and review, if applicable. Charles Zielinski indicated that the data presented to date, including the presentation from the June 18, 2019 status meeting, demonstrates the technical challenges of the IAOC and supports the remedy selection proposed in the RFSR. A formal response to NJDEP's comments on the RFSR, will be submitted to NJDEP by August 15, 2019.

### **Closing**

Thank you again for meeting to discuss this matter. A written response to the NJDEP's comments on the RFSR is anticipated to be submitted by August 15, 2019.

If you have any additional questions, please contact Michael Meyerhoefer of Kleinfelder at [mmeyerhoefer@kleinfelder.com](mailto:mmeyerhoefer@kleinfelder.com) or 631-671-7597.

Sincerely,  
**Kleinfelder, Inc**



David C. Hutnick  
Environmental Scientist



Michael Meyerhoefer  
Senior Project Manager

Electronic Copy:

Charles Zielinski – NJDEP SRP Case Manager  
Allan Motter – NJDEP BEERA Supervisor  
John Ruhl – NJDEP BEERA Technical Coordinator  
Iman Olguin-Lira – NJDEP BEERA Ecological Risk Assessor  
Maureen Forlenza, ExxonMobil  
John Groneck, ExxonMobil  
Michael Renzulli, LSRP  
Deborah LaMond, P66  
Corey Averill, Arcadis  
Justin Moses, Kleinfelder  
David Hutnick, Kleinfelder  
Paul Lucuski, Kleinfelder  
Project File

**Attachment 1**

Minutes from the January 24, 2018 Pre-application meeting with the NJDEP DLUR



**SENT VIA ELECTRONIC MAIL AND MAIL**

February 23, 2018

Ms. Katherine Nolan  
New Jersey Department of Environmental Protection  
Office of Permit Coordination and Environmental Review  
P.O. Box 420, Mail Code 401-07J  
Trenton, New Jersey 08625

**Re: January 24 Pre-Application Conference Notes  
Remedial Activities, Pitch Area (IAOC A18)**  
Bayway Refinery Complex  
Park Avenue and Brunswick Avenue  
Block 520, Lot 6  
City of Linden, Union County, New Jersey  
NJDEP SRP Program Interest (PI) No.: 008282  
NJDEP DLUR File No.: 2009-04-0001.1 FWW 150001 FWW 140001

Dear Ms. Nolan:

Thank you very much for coordinating a meeting with representatives of ExxonMobil Environmental Services Company (ExxonMobil), Phillips 66 (P66), the Licensed Site Remediation Professional (LSRP) and Kleinfelder, Inc. on January 24, 2018, for a Pre-Application Conference to discuss permits required for Investigative Area of Concern (IAOC) A18 conceptual remedial actions to be completed at the Bayway Refinery Complex (BRC) in Linden, New Jersey.

Below is a brief summary of our meeting, as requested. If this summary does not agree with your notes, please advise in writing.

**Conference Participants**

The January 24, 2018 Pre-Application Conference was attended by the participants listed below:

**New Jersey Department of Environmental Protection (NJDEP)**

Michelle Sebestyen – Permit Coordination and Environmental Review  
Cheryl Rohrbacher – Permit Coordination and Environmental Review  
Robert Hall – Surface Water Permitting  
Susan Lockwood – Division of Land Use Regulation Mitigation Unit  
Peter DeMeo – Division of Land Use Regulation  
Gary Nickerson – Office of Dredging and Sediment Technology  
Kenneth Komar – Water Allocation  
Charles Zielinski – Site Remediation Program  
Melisse Carasia Auriti – Bureau of Surface Water Permitting

## ExxonMobil, Phillips 66 and ExxonMobil's Consultants

Maureen Forlenza – ExxonMobil  
Deborah LaMond – P66  
Justin Moses – Kleinfelder  
Michael Meyerhoefer – Kleinfelder  
Nicole Joy – Kleinfelder  
Michael Renzulli – MR-LSRP

### **Conference Synopsis**

#### Project Overview

Kleinfelder provided an overview of IAOC A18, which is split into two distinct areas of concern:

- Former Pitch Disposal Area
- Mudflat Area

#### ***IAOC A18 Description***

IAOC A18 totals approximately 16 acres. It is bound by Morses Creek on its east, south, and west boundaries, and by the butane and propane caverns (IAOC A17) to the north. IAOC A18 includes the Former Pitch Disposal Area; the Mudflat Area; the former East Retention Basin (ERB, also referred to as the East Separator), which was filled in during 2016; the Heat Exchanger Cleaning (HEC) pad, which is no longer used for its intended purpose but is regularly used for materials storage; aboveground pipelines carrying crude oil (Boat Lines); and aboveground refinery pipelines including the out-of-service Inter-Refinery Pipeline (IRPL), multiple intra-refinery pipelines, high-pressure steam pipelines, and a cooling water pipeline (Salt Water Line [SWL]). The Boat Lines span the Mudflat Area and are two active 30-inch-diameter pipes supported by timber pilings that transfer crude oil from the waterfront area to the Tremley Tankfield, located south of IAOC A18. The SWL spans the Former Pitch Disposal and Mudflat Areas and is a 60-inch-diameter cast iron bell and spigot pipe supported by timber pilings constructed circa 1947 with selected repair sections constructed as recently as 2007. The SWL supplies non-contact cooling water from the Arthur Kill to BRC processing units at a rate up to 160,000 gallons per minute.

#### ***Former Pitch Disposal Area and Mudflat Description***

The Former Pitch Disposal Area is an approximately 4-acre area within IAOC A18. Pitch material is underlain by meadow mat (very compressible organic material) at depths ranging from between 4 and 8 to approximately 14 feet below ground surface (bgs). The pitch material consists of a low volatility, dark, viscous material (similar in composition to asphalt), containing a high percent of inert materials (typically >80% solids content), formed as a residue in the batch distillation of petroleum. Pitch material has been vertically delineated from 0 feet bgs to approximately 8 feet bgs.

The Mudflat Area is an approximately 12-acre area within IAOC A18 consisting of a mudflat that is transected by the poly ditch (operational ditch used by the refinery to discharge non-contact cooling water) and Boat Lines. The Mudflat Area becomes inundated by surface water from Morses Creek twice per day for half the lunar cycle. Water inundation occurs during high tide in the Arthur Kill, which causes water from Morses Creek to back up at Number 1 Dam. The mudflat

material consists of former dredge spoils from Morses Creek and is underlain by meadow mat at depths ranging from approximately 4 to 14 feet bgs. The mudflat is currently classified as intermediate wetlands, but vegetative growth only occurs in some locations, which are at higher elevations.

The project is in the conceptual phase, and this meeting was held to obtain feedback in support of the preparation of a revised Feasibility Study Report. As part of the conceptual project development, Kleinfelder is developing potential soil and groundwater remedial actions within IAOC A18. A pilot program is currently being developed to evaluate full-scale remedial action alternatives including: excavation, capping, barrier wall installation and constructed wetland enhancement. Future meetings with refined remedial approaches will be requested, at the appropriate time, to solicit NJDEP feedback.

Kleinfelder noted a number of accessibility and constructability challenges, which will impact design. ExxonMobil noted that this area is tidally influenced, but not tidal.

### Discussion

#### ***Water Allocation (Kenneth Komar)***

- The BRC currently has various remediation projects underway and others planned for the near future. Due to these various current and future projects, the Bureau has recommended to the applicant that they obtain either a Water Allocation Permit or Water Use Registration that would cover the various extraction and dewatering wells onsite. The applicant submitted to the Bureau, a summary of all onsite groundwater diversions, and identified their intent to file for a Water Allocation Permit on November 30, 2017.
- After reviewing the scope of the IAOC-A18 project, it appears that some dewatering may occur as part of this project. It is recommended that the applicant include this project, as well as all future planned remediation projects, as part of any application submitted to the Bureau.

#### ***Bureau of Surface Water Permitting (Robert Hall and Melisse Carasia Auriti)***

- A permit will be needed for any construction dewatering that may be discharged to surface water.
- Provided that the discharge is not contaminated, the appropriate discharge permit will be the B7 Short-term De Minimis Discharge General Permit (see <http://www.state.nj.us/dep/dwq/pdf/b7-rfa-checklist.pdf>). This is determined by running a pollutant scan, as described in the application checklist, where the data can be collected up to a year in advance of the discharge.
- If, however, the analytical results demonstrate levels greater than the standards (Appendix A) as specified in the de minimis permit (see <http://www.state.nj.us/dep/dwq/pdf/b7-deminimis-final-permit-5-20-15.pdf>), the appropriate New Jersey Pollutant Discharge Elimination System discharge to surface water permit will be the BGR General Groundwater Remediation Cleanup Permit (see <http://www.state.nj.us/dep/dwq/pdf/sw-gp-chklst.pdf>).



- The BGR permit can generally be processed in less than 30 days, although a treatment works approval may be needed for any treatment. Contact information is listed on the checklists.
- Discharging to the P66 wastewater treatment plant may be possible as it is likely designed to accept water impacted by industrial contaminants.
- If the discharge is petroleum related, a B4B general permit would be applicable instead of the BGR.

***Office of Dredging and Sediment Technology (Gary Nickerson), Division of Land Use Regulation (Peter DeMeo) and Mitigation Unit (Susan Lockwood)***

The proposed concepts may require the following permits and plans:

- Freshwater Wetlands General Permit 4
- Flood Hazard Area Verification
- Flood Hazard Area Individual Permit and possible Hardship Exception
- Stormwater Management Plan
- Mitigation Plan

***Mitigation (Susan Lockwood)***

- The mitigation unit will be working and consulting with the Division of Land Use Regulation to review land use permit applications and the mitigation plan.
- There will need to be a net balance at the site. If X acres are impacted, then X acres will need to be restored.

The detailed discussion of specific requirements is summarized below:

Mr. Nickerson asked Ms. Lockwood what mitigation would be required for this project. Ms. Lockwood stated that if the project area is restored to current condition, then mitigation would not be required. Since this area is currently not vegetated, restoration would include putting back what is removed at a ratio of one-to-one and stabilization, which may require some vegetation. Enhancement of this area may be possible, but the challenge will be determining functional plantings that can survive in this area. Kleinfelder stated that during the pilot program, test cells will be constructed to see what vegetative species can grow. Ms. Lockwood also emphasized understanding the hydrology and surface water inundation of this area to find suitable species to plant. It was also mentioned that enhancement of a contaminated area is considered an “attractive nuisance,” so clean material should be utilized for restoration.

***Flood Hazard Area (Peter DeMeo)***

Mr. DeMeo raised the need to determine the depth of fill necessary to prevent vegetative uptake of contamination and for compressibility/constructability within the Flood Hazard Area (FHA) in advance of application.

Mr. DeMeo stated that the FHA along Morses Creek is identified in the FEMA Flood Insurance Rate Map and that top of bank is the floodway. The drainage area of the Poly Ditch needs to be calculated to determine if this is a regulated water. If the drainage area is less than 50 acres, the ditch is not regulated and will not have a floodway. If the drainage area is more than 50 acres,

and if net fill is proposed for the project, then a HEC-RAS analysis, like the one performed for the Tremley Ditch, would be necessary to determine where the floodway is located. If the project is proposing only to excavate and fill to existing elevation (no net change), then a review of the Poly Ditch floodway and HEC-RAS analysis will not be necessary. The area is very flat, and the USGS Quadrangle map is not useful in determining the drainage area. Mr. DeMeo recommended getting site topography and calculating the drainage area.

Mr. DeMeo confirmed that the property owner is P66 and there are no easements that would be impacted by this project. Kleinfelder raised that construction access might be an issue in this area and that bridges may be necessary. Mr. DeMeo asked where these bridges would be anchored and noted evaluating the hydraulic impact. ExxonMobil stated that flow restriction is not allowable per the property owner, and the bridges would be floating style (pontoon). Mr. DeMeo asked how long the bridges will be in place, and Kleinfelder stated that construction would last for approximately three-quarters of a year. Mr. DeMeo noted that if in place longer than six months, the bridge would be considered a permanent structure and would need to be evaluated.

Mr. Renzulli clarified if ground surface needs to be raised 12 to 18 inches higher than existing conditions, that this would be acceptable. Mr. DeMeo stated that if outside of the floodway, then this is not a concern, since this is a tidal FHA, and there is no upper limit on filling within a tidal FHA. If this were a fluvial FHA, then this would not be the case.

#### *Stormwater Management (Peter DeMeo)*

The project will need to be evaluated for water quality, quantity and recharge. Recharge is not anticipated for this project due to the wet condition. For quantity, changes to land cover and hydrograph will need to be evaluated, and the proposed hydrograph cannot be made more severe. Eighty percent total suspended solid removal will be required if more than one-quarter acre of new impervious surface will be proposed. If a road is permeable, then no treatment will be necessary. ExxonMobil clarified that dense-graded aggregate is impervious and gravel is pervious. Due to heavy construction equipment and truck traffic, gravel roads may not be possible. If treatment is necessary, Mr. DeMeo suggested evaluating treatment somewhere else on site. If construction will last more than six months, then the construction phase will also need to be evaluated for stormwater management. ExxonMobil asked if there is any way to get a waiver on this requirement. Mr. DeMeo responded that a hardship exception may be feasible depending on the arguments presented. He also suggested an alternative could be to block off vehicular access to an impervious area on site. ExxonMobil also raised that if a best management practice design were implemented, a permit may be necessary for only a temporary measure.

ExxonMobil asked the question if TSS mitigation was performed in another area on-site and was removed after construction was complete, if this would be acceptable by NJDEP. Mr. DeMeo made the comment that NJDEP would prefer the mitigation measure be left in place because of its environmental benefits but ExxonMobil would not be legally obligated.

Mr. DeMeo stated that the proposed revisions to the stormwater management rules are in internal legal review and recommended a review on the status and impacts of these rules closer to the design and permitting phase. The proposed revisions to the stormwater management rules are not available for review at this time.

#### Additional Comments

Other comments were submitted by parties not able to attend the meeting, as listed below:

***New Jersey Division of Fish and Wildlife (Kelly Davis)***

***Threatened and Endangered Species***

- Habitat patches associated with this remediation proposal are valued as foraging habitat for a number of wading birds including State listed Black and Yellow-crowned Night-herons. Due to the existence of extensive alternative areas locally available for foraging the Division of Fish and Wildlife Endangered and Non-Game Species Program (ENSP) would not expect any long-term adverse impacts to these species from this project.
- Habitat patches associated with this remediation proposal are also valued for Bald Eagle foraging and a nest. Conditions supplied in previous permits, supplied with permit readiness checklists, would continue to apply. If it is determined that the nest is no longer occupied, consultation with ENSP/DLUR Threatened and Endangered Unit might determine means to minimize or mitigate for this condition.
  - Conditions applied in previous permits related to Bald Eagle have been lifted based on evaluation by the Division of Fish and Wildlife. The conditions were lifted in correspondence provided by NJDEP on April 7, 2015.

***Fisheries***

- A time restriction from May 1 through July 31 would be recommended on any in-water and/or sediment-generating activities associated with the project in order to protect warm-water fish nest building and spawning activities.
- Cofferdams installed prior to, or outside of, a recommended timing restriction might allow the applicant to work during the timing restriction. If a barrier wall acts similar to a coffer, it may be sufficient.
- Due to Number 1 Dam, this waterway would not be considered anadromous.

Any questions or concerns regarding fish and wildlife should be directed to Mr. Kelly Davis at (908) 236-2118 or [Kelly.Davis@dep.nj.gov](mailto:Kelly.Davis@dep.nj.gov).

***State Historic Preservation Office (Jesse West-Rosenthal)***

- Based upon the documentation submitted, there are no buildings, structures, sites, objects, or historic districts that are listed on, or that have been identified as eligible for listing on, the New Jersey or National Registers of Historic Places on or adjacent to the project location. Although the project setting is sensitive for archaeological sites, based upon a review of information on file at the Historic Preservation Office (HPO), the project only has a low potential for archaeological remains. Consequently, the HPO does not recommend further consideration prior to permit issuance.
- If additional consultation with the HPO is needed for this undertaking, please reference the HPO project number 18-0376 in any future calls, emails, submissions or written correspondence to help expedite your review and response. Any questions can be directed to Jesse West-Rosenthal at (609) 984-6019.

### ***Bureau of Nonpoint Pollution Control (Eleanor Krukowski)***

Construction projects that disturb 1 acre or more of land, or are part of a larger common plan of development that is greater than 1 acre, are required to obtain coverage under the Stormwater Construction General Permit (5G3). Applicants must first obtain certification of their soil erosion and sediment control plan (251 plan) from their local soil conservation district (SCD) office. Upon certification, the district office will provide the applicant with two codes (SCD certification code and 251 identification code) for use in the NJDEP online portal system application. Applicants must then become a registered user for the NJDEP online system and complete the application for the Stormwater Construction General Authorization. Upon completion of the application, the applicant will receive a temporary authorization, which can be used to start construction immediately, if necessary. Within three to five business days, the permittee contact identified in the application will receive an email including the application summary and final authorization. Further questions on this can be directed to Eleanor Krukowski at (609) 633-7021.

### ***Air Quality Permitting Program (Quddus Qayyum)***

It is recommended that N.J.A.C. 7:27-8.2 be reviewed to determine air permit applicability for all operations at this site, including the need to file for a new air permit(s) or to make changes to any existing air permit(s). Any questions should be directed to Quddus Qayyum at (609) 633-7021.

### ***Bureau of Tidelands Management (Marty Mosen)***

- The applicant was advised to follow up with the Bureau of Tidelands Management to determine if a tidelands license or grant will be required for proposed project. (Note: P66 is reviewing this requirement.)
- A tidelands license may be required for mitigation activities.
- Land use permits will need to be obtained before the Bureau of Tidelands Management can issue license.
- Tidelands inquiries should be directed to Marty Mosen at (609) 633-7900 or [Martin.Mosen@dep.nj.gov](mailto:Martin.Mosen@dep.nj.gov).

Michelle Sebestyen concluded the meeting by requesting that Katie Nolan be copied on all correspondence as the project progresses.

### **Closing**

Thank you again for meeting to discuss this project. We will schedule supplemental meetings as conceptual remedies are refined to solicit additional NJDEP feedback. Additionally, pre-application meetings with the Division of Land Use Regulation will be scheduled to review the conceptual design and confirm permitting and stormwater engineering requirements.

If we have other questions, we will contact the conference attendees for further clarification on permitting requirements, as needed, and will copy you on all permit applications. Please contact Nicole Joy of Kleinfelder at [njoy@kleinfelder.com](mailto:njoy@kleinfelder.com) or 609-454-4564 if you have any questions or require further information.



Sincerely,  
**Kleinfelder, Inc**



Nicole Joy  
Senior Staff Engineer

Hard Copy:

Alan Straus, USEPA  
Charles Zielinski, NJDEP Case Manager  
Project File

Electronic Copy:

Michael Renzulli, LSRP  
Deborah LaMond, P66  
John Groneck, ExxonMobil  
Maureen Forlenza, ExxonMobil  
Justin Moses, Kleinfelder  
Michael Meyerhoefer, Kleinfelder  
Michelle Sebestyen, NJDEP – OPCER  
Cheryl Rohrbacher, NJDEP – OPCER  
Robert Hall, NJDEP– BSWP  
Susan Lockwood – NJDEP DLUR Mitigation Unit  
Peter DeMeo, NJDEP – DLUR  
Christian Zografos, NJDEP – DLUR  
Gary Nickerson, NJDEP – ODS  
Kenneth Komar, NJDEP – Water Allocation  
Melisse Carasia Auriti, NJDEP – BSWP  
Eleanor Krukowski, NJDEP – BNPC  
Kelly Davis, NJDEP – F&W  
Quddus Qayyum, NJDEP – Air Permitting  
Jesse West-Rosenthal, NJDEP – SHPO  
Marty Mosen, NJDEP – BTM

**Electronic correspondence from the NJDEP Case Manager in response to the July 25, 2019 submittal, dated August 14, 2019.**

## David Hutnick

---

**From:** Zielinski, Charles <Charles.Zielinski@dep.nj.gov>  
**Sent:** Wednesday, August 14, 2019 1:20 PM  
**To:** Michael Meyerhoefer  
**Cc:** Ruhl, John; Motter, Allan; Olguin-Lira, Iman; Forlenza, Maureen P; mike@renzullilslrp.com; Lamond, Deborah; Paul Lucuski; Kozlowski, Nicole; David Hutnick  
**Subject:** RE: June 18, 2019 - ExxonMobil Bayway Pitch IAOC Meeting - Project Overview, Status Update and Response to NJDEP's Comments on the Revised Feasibility Study Report

Hi Mike,

The Department has reviewed the meeting notes from the June 18, 2019 Bayway Pitch IAOC meeting, and has the following comments to be reflected in revised meeting notes:

1. Follow-up Telephone Conversation – June 19, 2019: Per the follow-up telephone conversation, it was also stated that ExxonMobil must have a New Jersey licensed engineer certify (sign and seal) the technical impracticability statement/report for the entire IAOC, or any portion thereof where ExxonMobil is claiming Technical Impracticability.
2. Also, the Technical Impracticability and Pilot Study reports are supporting documents to the Revised Feasibility Study Report, and necessary to demonstrate the technical challenges of the Pitch IAOC. The data presented to date, including the presentation from the June 18, 2019 meeting, did demonstrate the technical challenges. However, the Department cannot concur the technical challenges are sufficient to support the RFSR proposed remedy selection without the Technical Impracticability and Pilot Study reports. These supporting documents will need to be submitted and reviewed by the Department.

Thank you,  
Charlie

Charles E. Zielinski  
State of New Jersey  
Department of Environmental Protection  
Site Remediation Program  
Bureau of Case Management  
Mail Code 401-05F  
PO Box 420  
Trenton, NJ 08625-0420  
Tel: (609) 292-0848



**New Jersey**  
**DEPARTMENT of**  
**ENVIRONMENTAL**  
**PROTECTION**

**Connect with us:**



---

**From:** Michael Meyerhoefer <MMeyerhoefer@kleinfelder.com>

**Sent:** Thursday, July 25, 2019 1:43 PM

**To:** Zielinski, Charles <Charles.Zielinski@dep.nj.gov>

**Cc:** Ruhl, John <John.Ruhl@dep.nj.gov>; Motter, Allan <Allan.Motter@dep.nj.gov>; Olguin-Lira, Iman <Iman.Olguin-Lira@dep.nj.gov>; Forlenza, Maureen P <maureen.p.forlenza@exxonmobil.com>; Groneck, John E <john.e.groneck@exxonmobil.com>; mike@renzullilrsrp.com; Lamond, Deborah <Deborah.Lamond@p66.com>; corey.averill@arcadis.com; Justin Moses <JMoses@kleinfelder.com>; David Hutnick <DHutnick@kleinfelder.com>; Paul Lucuski <PLucuski@kleinfelder.com>

**Subject:** [EXTERNAL] June 18, 2019 - ExxonMobil Bayway Pitch IAOC Meeting - Project Overview, Status Update and Response to NJDEP's Comments on the Revised Feasibility Study Report

Charlie,

I have attached the meeting notes prepared for the above referenced meeting. Thanks for taking the time and coordinating the meeting. We will provide you with a written response to the NJDEP's comments on the Revised Feasibility Study Report by August 15, 2019.

Please let us know if you have questions or would like to discuss in more detail.

Thanks,

Mike

**Michael J. Meyerhoefer**

Project Manager III

1200 Veterans Memorial Highway, Suite 300

Hauppauge, NY 11788

**d|** 631.787.8352

**o|** 631.218.0612

**m|** 631.671.7597



*This email may contain confidential information. If you have received this email—including any attachments—in error, please notify the sender promptly and delete the email and any attachments from all of your systems.*

**Response to the NJDEP's April 30, 2019 comments on the RFSR dated August 15, 2019.**



## ***Michael Renzulli - LSRP***

71 Potts Road, Robbinsville, NJ 08691

Office/Fax: 609-249-2699

Mobile: 609-744-7445

E-mail: [mike@renzullilsrp.com](mailto:mike@renzullilsrp.com)

August 15, 2019

Mr. Charles Zielinski  
New Jersey Department of Environmental Protection  
Bureau of Case Management  
P.O. Box 420. Mail Code 401-05F  
401 East State Street  
Trenton, NJ 08625

**RE: Bayway Refinery Complex Site Remediation  
Response to NJDEP's Comments  
Revised Feasibility Study Report letter dated April 30, 2019  
Investigative Area of Concern (IAOC) A18 (Pitch)  
Administrative Consent Order (ACO), Effective 11/27/1991  
SRP PI#008282**

Dear Mr. Zielinski:

Attached is one hard copy (original) and one electronic copy of the response to the Department's April 30, 2019 letter commenting on the Revised Feasibility Study Report (RFSR) for investigative area of concern (IAOC) A18 (Pitch Area) located within the Bayway Refinery Complex (BRC). The original Feasibility Study Report (FSR) for IAOC A18 was submitted to the Department in 2014 and was followed by a pre-design investigation (PDI) workplan in 2015. The attached correspondence summarizes the details of the presentation made by ExxonMobil at the Department's office on June 18, 2019.

As the listed Licensed Site Remediation Professional (LSRP) for the BRC, I have reviewed the attached document and I find the responses to be consistent with the discussion on June 18, 2019. It is my understanding that ExxonMobil will be submitting both a Technical Impracticability and Pilot Study report soon in support of the RFSR. Upon submittal, it is my hope that the Department can provide an expedited review and approval of the proposed remedy. Upon approval, a Remedial Action Workplan will be prepared and submitted to the Department.

Please contact me at (609) 249-2699 should you have any questions.

Best regards,

**Michael Renzulli - LSRP**



Michael J. Renzulli, P.G., LSRP

Enclosure

Cc: M. Forlenza – ExxonMobil Environmental and Property Solutions Company  
P. Lucuski - Kleinfelder



**ExxonMobil Environmental  
and Property Solutions Company**  
Park & Brunswick Avenue  
Building 7 – Site Remediation  
Linden, New Jersey 07036  
703.963.7132 Telephone

**Maureen P. Forlenza**  
Bayway Team Lead Project Manager



Date: August 14, 2019

Mr. Mike Renzulli, PG, LSRP  
Michael Renzulli - LSRP  
71 Potts Road  
Robbinsville, New Jersey 08691

**Re: Bayway Refinery Complex Site Remediation:  
Response to NJDEP's Comments  
Revised Feasibility Study Report letter dated April 30, 2019  
Investigative Area of Concern A18 (Pitch)**

**SRP PI# 008282**

Dear Mr. Renzulli:

Please find the attached correspondence providing responses to the New Jersey Department of Environmental Protection's comments to the August 30, 2018 Revised Feasibility Study Report (RFSR) prepared for Investigative Area of Concern (IAOC) A18 (Pitch). This response letter has been prepared on behalf of ExxonMobil Environmental and Property Solutions Company by Kleinfelder.

The correspondence is consistent with the details presented to NJDEP during the June 18, 2019 project status meeting that was held at the NJDEP's offices in Trenton, NJ.

Based on the NJDEP's e-mail correspondence dated August 14, 2019, the next steps will be to prepare a Pilot Study Completion Report and Technical Impracticability Report to support the RFSR. We will request a meeting with NJDEP to summarize the project details to the Technical Impracticability Report's reviewers and request an expedited review and approval of the proposed remedy to keep the project progressing forward. Upon approval of the RFSR, a Remedial Action Work Plan will be prepared and submitted to NJDEP.

Please contact me at (703) 963-7132 if you have any questions.

Sincerely,

A handwritten signature in black ink, appearing to read "Maureen Forlenza", written over a horizontal line.

Maureen Forlenza  
Bayway Team Lead Project Manager

Mr. Mike Renzulli, PG, LSRP  
Page 2

MPF/Enclosure

cc: B. Conetta – USEPA  
D. LaMond – Phillips 66 (electronically)  
R. Snyder – GHD (electronically)



August 14, 2019

Ms. Maureen Forlenza  
Bayway Team Lead Project Manager  
1900 East Linden Avenue  
Building 28A  
Linden, New Jersey 07036

**Re: Response to NJDEP's Comments**  
***Revised Feasibility Study Report* letter dated April 30, 2019**

Bayway Refinery Complex  
Park Avenue and Brunswick Avenue  
Block 520, Lot 6  
City of Linden, Union County, New Jersey  
NJDEP SRP Program Interest (PI) No.: 008282  
NJDEP DLUR File No.: 2009-04-0001.1 FWW 150001 FWW 140001

Dear Ms. Forlenza:

ExxonMobil Environmental and Property Solutions Company (ExxonMobil) received the above-referenced letter on April 30, 2019 via electronic mail. On June 18, 2019, a meeting between representatives of ExxonMobil, Phillips 66 (P66), the Licensed Site Remediation Professional (LSRP), Preferred Design Consultant – Arcadis (PDC), Kleinfelder, Inc. (Kleinfelder) and the New Jersey Department of Environmental Protection (NJDEP) Site Remediation Program (SRP) and Bureau of Environmental Evaluation and Risk Assessment (BEERA) was held to review the NJDEP's comments on the *Revised Feasibility Study Report* (RFSR) for Investigative Area of Concern (IAOC) A18 (Pitch Area) at the Bayway Refinery Complex (BRC) in Linden, New Jersey.

A summary of the meeting was submitted to the NJDEP on July 25, 2019.

Below is a response to each of the comments in the NJDEP's April 30, 2019 letter.

**NJDEP's Comments on the RFSR and Responses**

- **NJDEP Comment # 1** – *Section 4.3 Recommended Remedial Alternative of IAOC A18 states, '...perimeter sheet pile wall installation and impermeable cap installation is the recommended alternative for IAOC A18'. This alternative is not protective of the environment, leaving behind extremely elevated levels of contaminants on the site, eliminating the resource and violating the "no net fill" policy.*
  - **Response** - The proposed remedial action is protective of the environment, using a containment approach as implemented at other IAOCs at the BRC in accordance with the NJDEP-approved *Remediation Strategy Road Map* (Kleinfelder, 2018). The feasibility of enhancing the resource to improve the function and value of the wetland (which is largely devoid of vegetation) is being evaluated through an ongoing pilot study. The NJDEP Division of Land Use Regulation (DLUR) indicated during a permit pre-application meeting on January 24, 2018 that a net fill of the

Mudflat Area could be considered through the application for a hardship exception. A copy of the meeting minutes from the January 24, 2018 permit meeting were provided to NJDEP SRP in the July 25, 2019 correspondence.

As indicated above, the mudflat is largely devoid of vegetation, with the exception being those areas with a higher surface elevation. As a result, it is believed that the surface elevation of the mudflat is a controlling factor in establishing and sustaining vegetative growth on the mudflat. As a result, a key component of the pilot study is to establish the optimal elevation required for wetland vegetative growth. Because the subsurface materials in IAOC A18 are highly compressible, the addition of fill material will result in an elevation change, which is anticipated to be less than the thickness of the fill material placed. The potential consolidation of the existing subsurface and fill materials was modeled during the pre-design investigation (PDI) activities and is currently being measured and evaluated as part of the ongoing pilot study. Another objective of the study is to determine the least amount of fill material required to obtain the optimal elevation to sustain vegetative growth.

Lastly, floodway modeling of the Poly Ditch and Morses Creek is also ongoing to understand the potential flood impacts related to the placement of fill material and changes to the surface elevation of the Mudflat Area.

- **NJDEP Comment # 2** – *The recommended remedial alternative of perimeter sheet pile wall installation and impermeable cap installation will cover several acres of wetlands and transition areas. The only proposed remedy for this loss of wetlands is to perform a wetland vegetation pilot study. Contingency plans, such as wetlands creation and/or wetlands banking should be included in this report or an addendum to account for the possibility of failure of the pilot studies.*
  - **Response** – As noted above, the wetland vegetation pilot study is intended to address data gaps for enhancing the Mudflat Area as a vegetated wetland. The wetland vegetation pilot study itself is not the proposed remedy for potential loss of wetlands. The preferred course of action for IAOC A18 is to enhance the function and value of the existing wetland, or to replace it in-kind as part of the remedial action. If necessary, wetland creation at an alternative location and/or wetland banking would be included in a Remedial Action Workplan (which is scheduled to be submitted in the second half of 2020) if the results of the pilot study indicate that enhancement of the Mudflat Area as a vegetated wetland is not viable or a NJDEP DLUR hardship exception for placement of fill material within the floodway cannot be obtained.

The elevation required to support wetland vegetation is currently being evaluated as part of the ongoing pilot study, and the intent of the proposed remedial action is not to convert areas that are currently classified as wetlands to upland areas. Rather (as noted above), the majority of the mudflat is currently devoid of vegetation. Therefore, the intent of placing any fill materials over the mudflat would be to improve or enhance the function of the mudflat as a wetland resource. Finally, remedial actions that may result in changes to areas currently classified as wetlands are subject to the review and approval of the NJDEP DLUR Mitigation Unit prior to implementation.



- **NJDEP Comment # 3** – *Please submit all the previous data for the site. The figures submitted only displayed 2015 through 2016 data. Please revise the figures to display all sampling data collected on this IAOC.*
  - **Response** – Historical site data has been submitted to the NJDEP in previous reports, including the *Feasibility Study Report for the Pitch Area: Investigative Area of Concern – IAOC A18* [FSR, (TRC, 2014)]. Historical data will be presented in the forthcoming Remedial Action Workplan, along with data collected during PDI and Pilot Program activities.
- **NJDEP Comment # 4** – *No cost analysis has been submitted for any of the alternatives. Please include a cost analysis for each alternative.*
  - **Response** – A cost estimate will be included in the Remedial Action Workplan.
- **NJDEP Comment # 5** – *Section 1.1 Purpose and Scope, second paragraph states, “The portion of IAOC A18 east of the Poly Ditch is constrained by the Poly Ditch, Moses Creek, the Salt Water Line and Boat Lines. This area was not investigated previously, as it was thought to not be impacted due to:*
  - *The presence of the Poly Ditch prior to 1940 (as shown in historical aerial photographs); and*
  - *Construction of the pipelines and initiation of disposal practices of the Pitch Material in the 1940s (Geraghty & Miller, 1993).”*

*The Poly Ditch is part of a different IAOC and needs to be investigated with the rest of the Environmentally Sensitive Natural Resources (ENSRs) in its assigned IAOC. The statements above do not provide sufficient information indicating the Poly Ditch has not been impacted by the site’s operations. Investigating this area is the only way to reduce uncertainty. This statement will need to be redacted or eliminated from the report, because it is not part of this IAOC.*

- **Response** – The statement above from Section 1.1 of the RFSR pertains to the peninsula area to the east of the Poly Ditch, which is included in IAOC A18, but not the Poly Ditch itself which flows through IAOC A18. The area to the east of the Poly Ditch was first investigated during the PDI activities (2015 through 2016). Data from these investigation activities was presented in the RFSR. Additional investigation of the area to the east of the Poly Ditch was conducted during the Pilot Program (2018 through 2019). Details of the investigation of this area conducted during the Pilot Program will be included in the Remedial Action Workplan. The Poly Ditch is included as part of the final Consent Judgment and the remedy for the Poly Ditch will be implemented with the rest of the ENSRs in its assigned IAOC.

- **NJDEP Comment # 6** – *For the human exposure and wetlands transition areas, the Department acknowledges that multiple infrastructure appurtenances will impede the remediation of EPH free product and residual product at some locations. However, for those areas that are not impeded by infrastructure appurtenances, further evaluation is necessary to treat or remove EPH free product and residual product pursuant to N.J.A.C. 7:26E-5.1(e). Containment such as capping and perimeter containment should be considered only where removal or treatment are not practicable. The Department recommends that ExxonMobil consider removal and treatment options where removal and treatment are practicable, and that ExxonMobil differentiate these areas from the areas impeded by infrastructure appurtenances.*

- **Response** – ExxonMobil has considered removal and treatment options as presented in the July 2014 FSR. Additionally, the August 2018 RFSR proposed potential limited excavation and offsite disposal of pitch material and/or Mudflat Area soils as required to:

- Accommodate grading and installation of impermeable capping materials;
- Remove Pitch material that is contacting the salt water line (SWL) to allow installation of impermeable capping materials under the SWL; and
- Maintain required post-construction grades to support the growth of wetland vegetation planted in clean fill materials placed over the impermeable cap.

The removal areas are identified on figures included in the RFSR. Final areas where removal of pitch material and mudflat area soils is proposed will be presented in the Remedial Action Workplan.

- **NJDEP Comment # 7** – *ExxonMobil should develop a comprehensive map of historical total petroleum hydrocarbon (TPH) and extractable petroleum hydrocarbon (EPH) soil and sediment data for IAOC A18 including the vertical extents of TPH greater than 10,000 milligrams per kilogram (mg/kg) and EPH greater than 17,000 mg/kg. ExxonMobil should include information from the geotechnical soil boring logs (Appendix F) because the logs identify the presence of pitch, and from the descriptions in the boring logs of Appendix B (e.g., “residual oil” at a depth of 11 to 12 feet in ASB-861, “PITCH MATERIAL” in GMW-686, etc.). The locations of Historical LNAPL locations (Figure 7) should also be included and identified on the comprehensive TPH/EPH map. The infrastructure appurtenances and sized are not identical on all figures (e.g. Figure 5D versus Figure 12). ExxonMobil should include all infrastructure appurtenances and standardize the horizontal dimensions to be consistent between maps, especially maps where remediation evaluations are included.*

- **Response** - A comprehensive TPH/EPH map and geotechnical soil boring logs details will be included in the Remedial Action Workplan. Future regulatory submittals will also include figures that use standardized horizontal dimensions for various site features.

- **NJDEP Comment # 8** - *The Department specifies that 30,000 mg/kg is the ceiling concentration for Capping activities for soil (maximum ceiling number in the EPH calculator, when using the grain size). The elevated levels above 30,000 mg/kg EPH shall be removed to comply with N.J.A.C. 7:26E-5.1(e). The removal of high concentration[s] of free product was not evaluated in the report. If it is not practicable, a technical impracticability report shall be submitted as indicated in the Protocol for Addressing Extractable Petroleum Hydrocarbon guidance document.*
  - **Response** - As shown on figures included in the FSR and RFSR, EPH concentrations exceed 30,000 mg/kg throughout the Former Pitch Disposal Area, Mudflat Area and peninsula area east of the Poly Ditch in IAOC A18. The NJDEP has approved the implementation of similar containment remedial actions to address separate phase material at other IAOCs at the BRC, consistent with the NJDEP-approved *Remediation Strategy Road Map* (Kleinfelder, 2018), as those remedial actions were protective of potential receptors and the environment.

Moreover, it is not practicable to remove all soil with EPH concentrations above 30,000 mg/kg in IAOC A18 due to multiple constructability factors including the following:

- Extensive active refinery infrastructure

SWL – The SWL is a 60-inch diameter bell-and-spigot cast iron pipeline that was constructed in approximately 1955. The SWL is supported on timber piles, some of which have been reinforced with concrete pile caps. The SWL is located in the northern portion of IAOC A18 and extends from east to west through the Former Pitch Disposal Area, the Mudflat Area and the peninsula east of the Poly Ditch. Personnel can access the area to the south of the SWL via a scaffold that crosses over the line. Motorized equipment cannot access the area to the south of the SWL from the north. During the pilot study, lightweight motorized equipment accessed the area to the south of the SWL via a barge in Moses Creek. On the peninsula east of the Poly Ditch, personnel can access the area to the north of the SWL via elevated walkways constructed over the intra-refinery pipelines at the northern boundary of IAOC A18. Personnel must access the area on the peninsula east of the Poly Ditch south of the SWL via a boat launched from the eastern side of Moses Creek adjacent to the New Jersey Turnpike.

In addition to the accessibility challenges presented by the SWL, ground-intrusive work in the vicinity of the SWL is limited by several factors.

- Based on modeling performed by Kleinfelder, an unsupported 8-foot deep excavation (which is the maximum estimate depth of the pitch material) is not feasible near the SWL due to potential slope instability. The wooden piles are sensitive to lateral displacement and displacements as small as 1 inch could result in overstressing of the piles and potential failure of the SWL.
- Construction activities such as sheet pile installation or

operation of construction equipment near the SWL can generate vibration which can potentially affect the timber piles. Vibration monitoring has been conducted via seismographs installed along the alignment of the SWL throughout Pilot Program activities. Thresholds specified in the SWL Monitoring Plan for the Pilot Program have not been exceeded during construction activities. However, seismic monitoring will be required during any future construction activities near the SWL and any vibrations in excess of the thresholds could jeopardize the integrity of the pipeline and would require work to be stopped and/or additional controls implemented.

- P66 has previously required a 40-foot buffer centered on the SWL (20 feet on either side of the SWL). Excavation activities are prohibited within this buffer area.
- The SWL is a critical piece of refinery infrastructure and operations. A breach in this line would not only disrupt refinery operations but would also likely result in loss of life for any workers in this area.

Crude Oil Boat Lines – Two 30-inch diameter and two 24-inch diameter steel pipelines traverse the mudflat area and peninsula east of the Poly Ditch from the northeast to southwest. These pipelines transfer crude oil between the Waterfront Area to the east of IAOC A18 and the Tremley Tank Field which is located to the southwest of IAOC A18. The Crude Oil Boat Lines are supported on timber piles and are elevated approximately 3 to 5 feet above ground surface. Personnel can access the area to the southeast of the Crude Oil Boat Lines by crossing the scaffold over the SWL and walking under the Crude Oil Boat Lines. Motorized equipment cannot access the area to the southeast of the Crude Oil Boat Lines from the northeast. During the pilot study, lightweight motorized equipment accessed the area to the southeast of the Crude Oil Boat Lines via a barge in Morses Creek. Access to the peninsula east of the Poly Ditch is as described above in the SWL section.

Like the SWL, P66 has required a 40-foot buffer centered on the Crude Oil Boat Lines (20 feet on either side of the center line of the Crude Oil Boat Lines). Excavation activities are prohibited within this buffer area.

To date, vibration monitoring has not been conducted on the Crude Oil Boat Lines because vibration-generating construction activities have not been conducted in proximity to these lines. However, baseline vibration monitoring and monitoring during construction activities will be conducted at a later date. Similar to the SWL, the Crude Oil Boat Lines are critical refinery infrastructure. A breach in the lines would result in a disruption to refinery operations, a release to the environment and potential injury or loss of life for workers in this area.

Intra-refinery pipelines – The intra-refinery pipelines are located on metal pipe racks extending northwest to southeast at the northern boundary of IAOC A18, adjacent to the butane/propane caverns area (IAOC A17). These active pipelines carry various liquids and gases throughout the production units in the BRC. Pitch material has been observed beneath the intra-refinery pipelines and within the rectangular area located between these pipelines. Access to this rectangular area is restricted by the pipelines. Personnel can access this area via elevated walkways from the butane/propane caverns area (IAOC A17) to the north, but motorized equipment cannot access this area.

Like the SWL and Crude Oil Boat Lines, P66 has required a 40-foot buffer centered on the intra-refinery pipelines (20 feet on either side). Excavation activities are prohibited within this buffer area.

To date, vibration monitoring has not been conducted on the intra-refinery pipelines because vibration-generating construction activities have not been conducted in proximity to these lines. Baseline vibration monitoring and monitoring during construction activities will be conducted at a later date. As with the other pipelines in this IAOC, the intra-refinery pipelines are a key piece of refinery infrastructure. A breach in the lines would potentially result in a disruption to refinery operations, a release to the environment and potentially injury or loss of life for workers in this area.

- Site conditions

Surface Water Bodies – There are two significant surface water bodies adjacent to or within IAOC A18 – Morses Creek and the Poly Ditch. Morses Creek forms the southwestern, southern and southeastern boundaries of IAOC A18. The Poly Ditch, which is an operational ditch used by the BRC to discharge non-contact cooling water, flows from northwest to southeast and enters Morses Creek at the eastern side of IAOC A18. The Poly Ditch transects IAOC A18 and restricts access to the peninsula at the eastern side of the IAOC.

Morses Creek is a tidal water body from No. 1 Dam to the confluence with the Arthur Kill. No. 1 Dam is the head of tide for the BRC. Upstream of No. 1 Dam including adjacent to IAOC A18, Morses Creek and the Poly Ditch are tidally influenced, but are not considered tidal water bodies. Specifically, as the tidal elevation rises, surface water discharge from Morses Creek at No. 1 Dam is restricted, which in turn influences the surface water elevation of Morses Creek and the Poly Ditch. Surface water inundates the Mudflat Area at depths up to 16 inches twice a day during half of the lunar cycle. The approximate high-water line and photographs of the Mudflat Area during periods of surface water inundation were shown during the June 18, 2019 meeting. Such periodic inundation would present several safety, logistical and constructability challenges associated significant excavation of pitch material and/or Mudflat Area soils.

Accessibility – Portions of the Former Pitch Disposal Area and Mudflat Area north of the SWL are currently accessible to equipment such as drill rigs



and excavators via the temporary access road that has been constructed for the ongoing Pilot Program activities. Prior to construction of this road, there was limited means of accessing these areas with motorized equipment due to the soft surface and highly compressible subsurface materials. Limited equipment operations have been conducted in the Mudflat Area south of the SWL as access to this area must be obtained via a barge in Morses Creek.

Surface/Subsurface Conditions – Both the Former Pitch Disposal Area and Mudflat Area are underlain by a meadow mat layer which is highly compressible and unable to support most motorized equipment. The pitch material is a relatively soft asphalt-like material that becomes softer during the warmer months of the year. Pitch material is less compressible than the meadow mat layer and is generally displaced outward rather than compressing when a load is applied to the surface. Additionally, Mudflat Area soils are soft and have typically been unable to support motorized equipment without structural support elements such as swamp mats, even during periods of the lunar cycle when the Mudflat surface is not inundated with surface water. Based on equipment trials during the Pilot Program, the largest equipment that can be supported on the Mudflat Area with swamp mats is approximately 6,000 to 8,000 pounds.

The above details illustrate the impracticability of selecting a remedial approach that includes the *“removal of high concentration of free product”*. These factors were considered when completing the remedial alternatives evaluation and remedial selection.

- **NJDEP Comment # 9** - *Please provide a full vertical and horizontal delineation of the pitch material where EPH elevations are greater than 30,000 mg/kg.*
  - **Response** - See response to NJDEP Comment #7.
- **NJDEP Comment # 10** - *Section 3.1.4 Potential Vapor Generation Evaluation discusses an evaluation of background VOC concentrations in the former Pitch Area. An air sample was taken in December 2015 and total VOCs and benzene were detected; these results were considered representative of background conditions in the Pitch Area. A more current air sample should be collected to appropriately represent background conditions under current conditions.*

*It is proposed to use the results of the potential vapor generation evaluation along with exposure limits set by OSHA to develop vapor mitigation levels for future intrusive activities. However, many of OSHA PELs are outdated and inadequate for ensuring protection of worker health because most of OSHA's PELs were issued shortly after adoption of the Occupational Safety and Health Act in 1970 and have not been updated since that time. OSHA recommends that employers consider using alternative occupational exposure limits because the Agency believes that exposures above some of these alternative occupational exposure limits may be hazardous to workers, even when the exposure limits are in compliance with the relevant PELs. It may be more appropriate to use NJDEP Vapor Intrusion Screening Levels to develop mitigation levels. The development of these mitigation levels should be discussed jointly with USEPA and the Department.*

- **Response** - Appropriate worker safety action levels that meet the applicable regulations and company standards will be included in the site-specific Health and Safety Plan.

Based on the e-mail correspondence received from the NJDEP on August 14, 2019, the next steps will be to prepare a Pilot Program Completion Report and Technical Impracticability Report. We will review and provide a schedule for delivery of these reports. Before submitting the Technical Impracticability Report, we will request a meeting with the NJDEP's reviewers to provide background and a project status update. Additionally, we will request an expedited review and approval of the proposed remedy in order to continue to progress the project.

If you have any additional questions, please contact Michael Meyerhoefer of Kleinfelder at [mmeyerhoefer@kleinfelder.com](mailto:mmeyerhoefer@kleinfelder.com) or 631-671-7597.

Sincerely,  
**Kleinfelder, Inc.**



David C. Hutnick  
Environmental Scientist



Michael Meyerhoefer  
Senior Project Manager

Electronic Copy:

John Groneck, ExxonMobil  
Michael Renzulli, LSRP  
Deborah LaMond, P66  
Corey Averill, Arcadis  
Justin Moses, Kleinfelder  
Project File